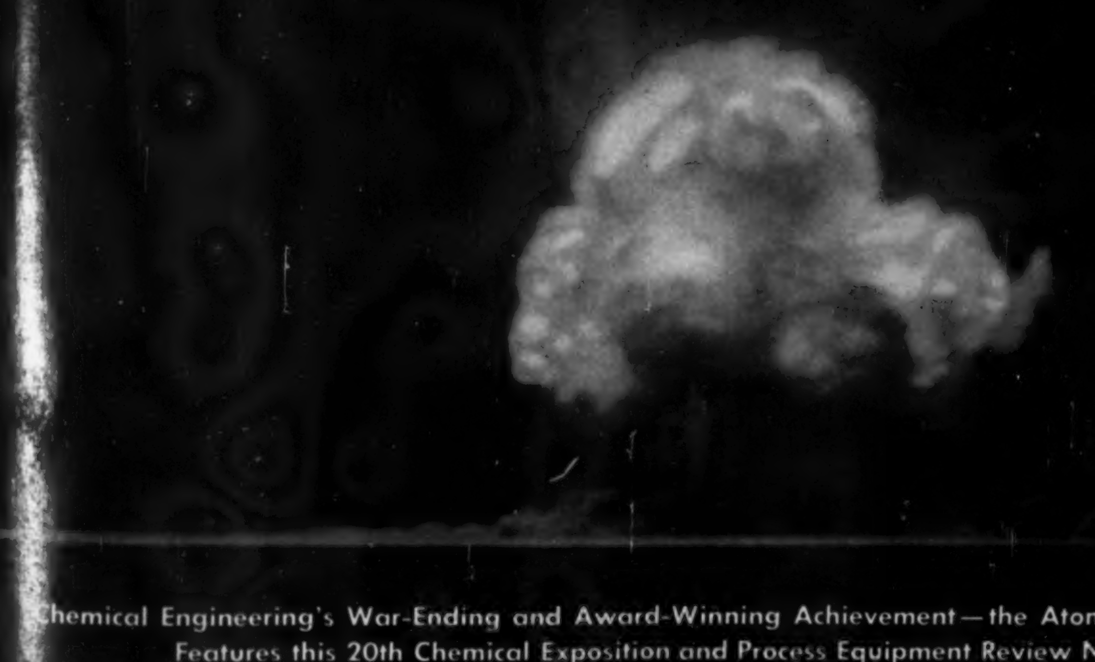
CHEMICAL
& Metallurgical
ENGINEERING

for FEBRUARY, 1946



Chemical Engineering's War-Ending and Award-Winning Achievement—the Atomic Bomb Project Features this 20th Chemical Exposition and Process Equipment Review Number.

an important feature of the Tube Turns line

WHEN a 180° fitting must be cut to an odd angle to meet special conditions, uniform wall thickness is of prime importance. Tube-Turn fittings have uniform wall thickness within ASA tolerances at all points throughout the fitting. Cut to any odd angle, they will line up perfectly with the pipe.

There are more than 4,000 items in the complete Tube Turns line—the *first* line of seamless welding fittings, in point of time, in strength, safety, economy and efficiency. Among refineries, processing plants, power plants and equipment manufacturers, Tube-Turn welding fittings are known for all around excellence and dependability.

The long and varied experience of Tube Turns engineers is available to you through selected Tube Turns distributors in every principal city, commanding the full resources of all Tube Turns branches and the home office. Write today for your free copy of Catalog 111.

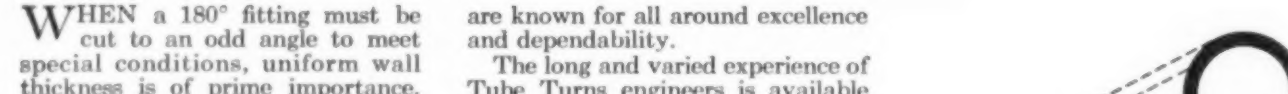
• • •

Selected Tube Turns distributors in every principal city are ready to serve you from their complete stocks.

TUBE TURNS (Inc.), Louisville 1, Kentucky. Branch Offices: New York, Washington, D. C., Philadelphia, Pittsburgh, Cleveland, Detroit, Chicago, Houston, San Francisco, Seattle, Los Angeles.

Quality control and inspection assure uniform wall thickness within ASA tolerances at all points. Full circularity is maintained throughout.

TUBE-TURN TRADE MARK tt *Welding Fittings and Flanges*



CHEMICAL
& Metallurgical
# ENGINEERING

FEBRUARY • 1946

Volume 53 Number 2

S. D. KIRKPATRICK............*Editor*
JAMES A. LEE.........*Managing Editor*
THEODORE R. OLIVE..*Associate Editor*
HENRY M. BATTERS.....*Market Editor*
LESTER B. POPE.......*Assistant Editor*
RICHARD W. PORTER..*Assistant Editor*
EDMOND C. FETTER...*Assistant Editor*
RICHARD F. WARREN..*Assistant Editor*

EDITORIAL REPRESENTATIVES
JOHN R. CALLAHAM...*San Francisco*
J. V. HIGHTOWER........*Washington*
EARLE MAULDIN.............*Atlanta*
R. S. McBRIDE............*Washington*
E. S. STATELER..............*Chicago*

M. A. WILLIAMSON..........*Publisher*

DISTRICT MANAGERS
E. H. BEDELL..............*New York*
R. G. FREDERICK.........*New York*
FRED GRANT...............*Cleveland*
L. A. CUNNINGHAM..........*Chicago*
W. D. BOYD...................*Boston*
E. M. SCHELLENGER.....*Philadelphia*

Published monthly. Price 35 cents per copy. Publication office, 99-129 North Broadway, Albany 1, N. Y. Address communications about subscriptions to Vice-President (for circulation operations), Chem & Met., 330 West 42nd St., New York 18, N. Y. Subscription rates: United States, Mexico, Central and South American Countries. $3 per year, $4 for two years, $5 for three years. Canada $3.50 per year, $5 for two years, $6 for three years (payable in Canadian funds). All other countries, $5 per year, $10 for three years. Please indicate position and company connection on all subscription orders. Entered as second class matter September 3, 1936, at Post Office at Albany, N. Y., U.S.A. under act of March 3, 1879.

Branch offices: 520 North Michigan Avenue, Chicago 11; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W. C. 2; Washington 4; Philadelphia 2; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; Los Angeles 14; Atlanta 3; Pittsburgh 22.
Return Postage Guaranteed

McGRAW-HILL PUBLISHING CO., INC.

JAMES H. McGRAW
Founder and Honorary Chairman

Publication Office
99-129 North Broadway, Albany 1, N. Y.
Editorial and Executive Offices
330 West 42nd Street, New York 18, N. Y.
JAMES H. McGRAW, Jr., *President;* CURTIS W. McGRAW, *Senior Vice-President and Treasurer;* HOWARD EHRLICH, *Vice-President and General Business Manager;* EUGENE DUFFIELD, *Editorial Assistant to the President;* JOSEPH A. GERARDI, *Secretary;* and J. E. BLACKBURN, Jr., *Vice-President* (for circulation operations).
Member A.B.P. Member A.B.C.
Cable Address McGRAWHILL New York

Price of this issue, one dollar per copy

In this Issue

CHANGE OF ADDRESS

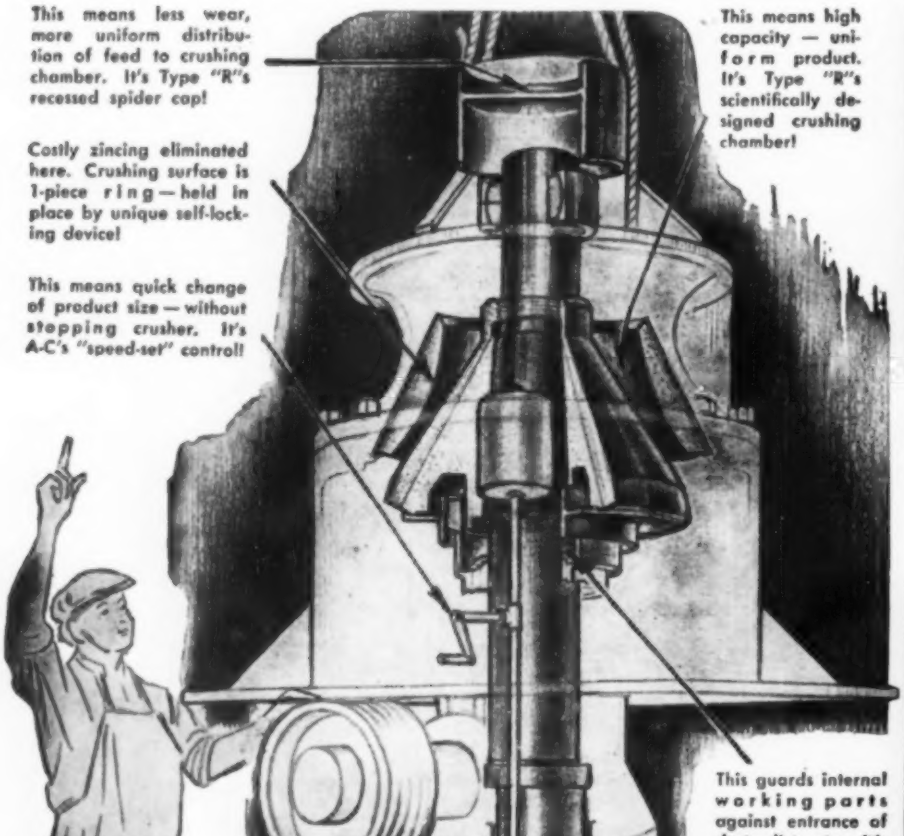
Director of Circulation
Chemical & Metallurgical Engineering
330 West 42nd Street, New York 18, N. Y.

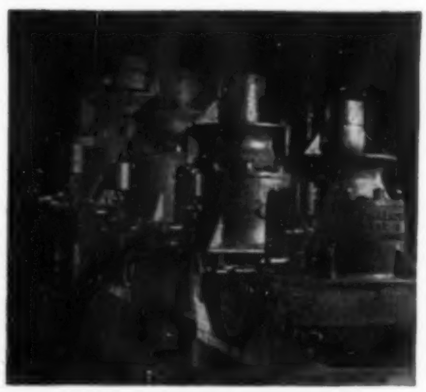
Please change the address of my *Chem. & Met.* subscription.

Name ....
Old Address ....
New Address ....
New Company Connection ....
New Title or Position ....

Need Capacity?

A-C'S TYPE "R" SECONDARY CRUSHER GIVES YOU HIGH CAPACITY, CLOSER CONTROL, A MORE UNIFORM PRODUCT —AT A LOWER COST PER TON!





1 Want *proof?* Compare it with *any other crusher* in same price range. At a given setting, Type "R" will give you a *more uniform* product, *greater capacity* of size of product you require!

2 All wearing parts are heat-treated manganese steel. Their non-choking, uniform wear design permits close setting — enables production of fine stone or excellent ball mill feed.

CHEMICAL
& Metallurgical
# ENGINEERING

ESTABLISHED 1902 S. D. KIRKPATRICK, Editor

FEBRUARY 1946

WAR'S BYPRODUCTS

THE LATE Francis P. Garvan was often quoted as saying that all America got out of World War I was its organic chemical industry. Others may not agree but certainly it was an important byproduct that has since proved of incalculable value to the national economy for its stimulating contributions to health, happiness and security. What, if anything, has come out of this war that is comparable in national and international significance?

The answer, it seems to us, is found in the new strength and vigor and resourcefulness of American industry. There has been no job too big or too complicated. The real secret of the atomic bomb is the same know-how and engineering enterprise that produced a hundred thousand airplanes with superior fuel and firepower, guided by radar to deliver a tremendous tonnage of super explosives. It is the same industrial ingenuity and organization that gave us, within two years, a million tons of synthetic rubber or billions of units of penicillin. Blood plasma and magnesium, DDT and plutonium, but why continue? Behind them all is a technology in which chemical engineering played an important role.

So it is that we have arrived at our slogan for this 20th Chemical Exposition Number of *Chem. & Met.* "War's Most Promising Byproduct" is "Chemical Engineering Progress for Peace." Within our hands is a great productive force. It can and must be put to work for the lasting good of America and the world. No job is too big for it.

THE GREATEST SHOW ON EARTH

IT'S GOOD to be back in Grand Central Palace again. The last Chemical Exposition here closed on the very eve of Pearl Harbor. Many things have happened since then but we have all looked forward to this day when we could start again to build for peacetime production, to translate into plants and processes the plans and dreams that have come from our research and development laboratories. This is the way our industries have grown in the past and how they must continue to grow in the future.

In this progressive process, the "Chem. Show" has always played a most important part. It provides the great stimulus that comes from a matching of minds, from the interchange of ideas between science and technology, between creative research and engineering know-how. If we are smart we take advantage of the opportunity—not only to find out what is new and interesting, but also to explore the less obvious possibilities that so often solve our production problems.

This 20th Exposition of Chemical Industries is especially timely. Industrial reconversion is in a formative stage and ideas gained today can be put to immediate use. Exhibitors have more to show and talk about than ever before. The wraps of military secrecy have been taken off of most of their developments and they are eager to apply their wartime experience to the normal processes of industry. Critical materials that were once scarce or rationed only to war production are becoming available in greater abundance. New products that have proved their worth in other fields are waiting for appraisal and use in chemical industries.

To the tens of thousands of chemists, engineers and industrialists who come to New York for this biennial exposition, it is truly "the greatest show on earth." It is something we have been waiting for. Let's make the most of it!

PHYSICO-CHEMICAL ENGINEERING

SOME years ago a professor from the University of Delft showed us an outline of a course he was then developing under the name of "Physical Technology." We were immediately impressed by its close resemblance to the American concept of chemical engineering. Major emphasis was on distillation, absorption and extraction, drying, filtration and the various mechanical separations—all unit operations to us, but merely units of physical technology to our Dutch friend. We were reminded that in many ways physics rather than chemistry is the underlying science of modern chemical engineering.

Today that basic relationship between the physicist and the chemical engineer takes on new significance. We are emerging from a war in which many of the major technical achievements have had their origin in the physics, rather than the chemistry laboratories. The physicists by their more intimate association with electronics, solved the engineering problems of producing and directing micro waves and thus gave us the basis of radar. The newer science of "nucleonics" is certainly not wholly the field of the nuclear physicists but again we must give them credit, not only for their pioneering discoveries but also for suggesting the methods of application and utilization. From the latter may some day emerge the nuclear engineers of the future.

This physical renaissance is of current concern to chemical engineers. The most important method and plant for separating the isotopes of uranium by gaseous diffusion has been correctly called "the largest continuous chemical-physical process in the world." Its success was the result of team work of chemists, physicists and engineers. We can expect to see more such combinations in the future. The physicist is coming out of his academic shell to emerge into a practical world of engineering processes and products. The

chemical engineer, by training and experience, by viewpoint and methods, is best equipped to work with him in that transition period. Both have much to gain in the process.

STOCKPILE OR SUBSIDY

SCARCITY of strategic materials created much of our military difficulty at all stages of the war. Thus it takes little argument to persuade Congress that stockpiles of such materials should be established and maintained within the United States for many of these commodities. Those who start from that sound premise often reach also some wild and unjustified conclusions, as they seek to use the real need for stockpiles as an excuse for subsidy for certain industries.

Some of the spokesmen of the mineral industries seem particularly guilty of this form of distortion. They argue that since certain metals and minerals were scarce during the war there should be permanent subsidy for production of those commodities during peacetime at deposits which are otherwise submarginal. Such a policy would deplete the high-cost mineral reserves and would not create anything new within the United States. The sole beneficiary would be those owners of mineral deposits of this character who have no hope for successful commercial operation in a competitive market.

To some legislators of Washington that philosophy offers an attractive short-time political advantage. Fortunately they were defeated in their effort in the Senate during December when that body decided to restrict the stockpile bill to the building of real stockpiles for genuine preparedness.

Chemical industries have a considerable stake in this issue. If these high-cost reserves are so developed, there is almost certain to be a simultaneous boost in the market price of the metals and minerals so subsidized. And there is grave danger that later political manipulations of stock piles may actually destroy a reserve which we can keep in the ground in safety for use in the event that later we should urgently need those high-cost reserves. It is important that the legislators in both houses of Congress be fully informed as to the danger of such distortion of stockpile policy.

THE BASIC CAUSE OF DELAY

PERHAPS no single factor so much delays reconversion and establishment of expected peacetime industry as does the scarcity of technologic manpower. That is a very strong statement at a time when nationwide strikes have upset great sections of industry. But still it appears true.

Hundreds of new projects that should go ahead immediately lack some further laboratory testing, some pilot plant development, some engineering design, or some other technical details. Industry has thousands of projects for which money and manpower and market are ready. But technical skill is lacking for final details which hold up authorizations of new units or whole new plants.

This is the inevitable consequence of the shortsighted manpower policies of the war period. Thousands of scientists and engineers toted guns, drove jeeps, and did other tasks for which their professional training was of no aid. Somebody had to do those tasks. Perhaps the technical men did them as well, but probably no better, than any equivalent number of other young men without that technical training. It was only by extreme measures that we kept for even the atomic bomb project a few irreplacable scientists and engineers. And, probably properly, most of those skilled professional workers are still tied up by atomic bomb investigations and developments not yet completed.

The over-all result has been that we have lost about ten years production of technical brains. Even now Selective Service continues its stupidities and gives only half-hearted, ineffective provision for deferment for those seeking technical training at the higher levels.

America is going to pay very heavily in the next decade while it struggles to catch up in supply of technical brainpower. America is the only great nation that was so shortsighted as to have cut itself off from technical progress in this manner. We must continue to hammer on this fact because the legislators in Washington still do not fully understand it.

BUGABOO OF BUREAUCRACY?

EXTENDED proceedings before the Senate Committee which is dealing with science legislation show that the legislators are being made conversant with most of the basic factors involved in the government's part of this job. They also show, more by omission than by open statement, that some industrial spokesmen have not quite fully understood the proper and valuable part which government can play in the process. These technical men seem to fear that a National Research Foundation might become something competitive with individual enterprise. Certainly there is privately a recurring expression of fear that such will be the case.

There is theoretically such a danger. But practically there now seems to be more evidence in Washington than at any time during the past fifteen years of the intention of Congress to establish and to guide such a Foundation along lines that will support and not conflict with the private enterprise system. We believe that the benefit of new knowledge to be gained from such a Foundation would far outweigh the remote and possible hazard of government interference.

IMPORTANT CORRECTIONS!

AFTER the following report on the seventh biennial Award for Chemical Engineering Achievement had already been printed for binding in this issue, attention was called to several unfortunate omissions from the list of prime contractors that are to share with the Manhattan Engineer District in this recognition of those who contributed most significantly to the engineering and research phases of the atomic bomb project. In accordance with the rules agreed upon by the Committee of Award and the commanding officers of the Manhattan District, each of these cases was carefully reviewed by the latter who have ruled that the following companies should be included in the list of recipients: J. F. Pritchard & Company, Kansas City, Mo.; The Marley Company, Inc., Kansas City, Kan.; A. O. Smith Corporation, Milwaukee, Wis.; F. J. Stokes Machine Company, Philadelphia, Pa.; and Worthington Pump and Machinery Corporation, Harrison, N. J. Omitted inadvertently from the original list published on page 112 of our January issue but included in the corrected list this month is The Babcock and Wilcox Company of New York, N. Y. For these and perhaps even more serious shortcomings not yet revealed to the Award Committee and the officers of the Manhattan Engineer District, we offer our humble apology. —EDITOR.

CHEMICAL ENGINEERING'S WAR-ENDING ACHIEVEMENT THE ATOMIC BOMB

Hiroshima! Nagasaki! Japan surrenders! Thus ended World War II. And back to its niche in the Louvre went Nike of Samothrace, the winged and wounded goddess that for 2200 years has stood as a symbol of hard fought victory.

The atomic bomb was but the climaxing incident in a dramatic series of war-ending events. Victory was the result of tremendous effort, of teamwork of many forces — military and civilian, of many weapons and machines of war, all made possible by the industry and ingenuity of many peoples and professions.

Nor was the atomic bomb the achievement of any individual or of any profession. Rather, it, too, was the result of group effort, of the work of a giant team of physicists and chemists, engineers and industrialists, military and governmental administrators. That after half a century of physical and chemical research the scientists of the world could have discovered the means of releasing atomic energy, and thus creating the basis for its application, lies at the very genesis of the project. That they should have foreseen its potentialities and brought them forcefully to the attention of our political and military leaders is to their lasting credit. Then came the secret, urgent researches in American universities and the further discoveries that were to form the basis for a practical program of almost inconceivable size and complexity.

When, in June 1942, the Army was assigned the job of coordinating the construction and operation of the huge atomic bomb plants, it is

significant that the War Department turned to the Corps of Engineers. Here the engineering profession was to find the greatest challenge in its history — one that called for the cumulative know-how of 50 years of American engineering and industrial progress.

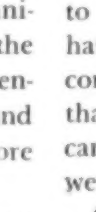
Following and coincident with the research came the need for development engineers to translate the unique results of the laboratory into workable processes and equipment — jobs for thousands of chemical engineers in a field in which they have always shown remarkable proficiency and resourcefulness. Closely behind were the design engineers — mechanical, electrical, metallurgical — to serve as the vanguard of the civil engineering and construction forces. The plants to be built were not only fantastically big but many of them had no counterparts anywhere in the world. Finally came the plant operators, all technically trained men, capable of quickly mastering the complicated procedures and controls that were essential in the large scale production of dangerous and exceedingly valuable materials that had never before been made, except in laboratory experiments.

By placing all phases of the atomic bomb project under the general administration of Major General Leslie R. Groves, the War department was assured of capable, aggressive direction for the Manhattan Engineer District, and also the maximum cooperation, not only with the civilian agencies but with all other branches of the Armed Services. Colonel Kenneth D. Nichols, Manhattan district engineer, has aptly described the atomic bomb project as an "accomplishment which will endure as a monument to the ingenuity, vision and determination of all those, from scientists to laborers, who have had a part in the work. These people and organizations — scientific, engineering, contracting, manufacturing, procuring and others — working in close harmony among themselves and with government agencies, deserve unlimited credit for the successful accomplishment of an almost impossibly vast and complicated task!"

Because the Atomic Bomb Project so well exemplifies the sort of group effort for which the Award for Chemical Engineering Achievement was established in 1933, the committee has voted unanimously to present the seventh biennial award to the Manhattan Engineer District and through it to those companies, universities and research organizations, that as prime contractors contributed so significantly to the scientific research and engineering that were responsible for the success of the project.

Chemical & Metallurgical Engineering, as sponsor for this Award for Chemical Engineering Achievement, is pleased to join with the chemical engineering profession in thus honoring these units of American industry and education.

SIDNEY D. KIRKPATRICK,
Feb. 15, 1946 *Secretary, Committee of Award*



Committee of Award for Chemical Engineering Achievement

Professor ALFRED H. WHITE, Chairman Professor Emeritus, Department of Chemical and Metallurgical Engineering, University of Michigan, Ann Arbor, Mich.

SIDNEY D. KIRKPATRICK, Secretary Editor, Chemical & Metallurgical Engineering, New York, N. Y.

CHARLES S. KEEVIL, Bucknell University, Lewisburg, Pa.

WILLIAM N. LACEY, California Institute of Technology, Pasadena, Calif.

WARREN L. McCABE, Carnegie Institute of Technology, Pittsburgh, Pa.

CARL F. PRUTTON, Case School of Applied Science, Cleveland, Ohio

REUBEN S. TOUR, University of Cincinnati, Cincinnati, Ohio

CHARLES HECKER, Clarkson College of Technology, Potsdam, N. Y.

ARTHUR W. HIXSON, Columbia University, New York, N. Y.

ARTHUR H. RADASCH, Cooper Union, New York, N. Y.

FRED H. RHODES, Cornell University, Ithaca, N. Y.

ALLAN P. COLBURN, University of Delaware, Newark, Del.

CHARLES G. DUNCOMBE, University of Detroit, Detroit, Mich.

LEON D. STRATTON, Drexel Institute of Technology, Philadelphia, Pa.

WALTER H. BEISLER, University of Florida, Gainesville, Fla.

JESSE W. MASON, Georgia School of Technology, Atlanta, Ga.

HARRY McCORMACK, Illinois Institute of Technology, Chicago, Ill.

H. F. JOHNSTONE, University of Illinois, Urbana, Ill.

ORLAND R. SWEENEY, Iowa State College, Ames, Ia.

C. SHERMAN GROVE, State University of Iowa, Iowa City, Ia.

CHARLES F. BONILLA, Johns Hopkins University, Baltimore, Md.

HARVEY A. NEVILLE, Lehigh University, Bethlehem, Pa.

PAUL M. HORTON, Louisiana State University, Baton Rouge, La.

ROBERT C. ERNST, University of Louisville, Louisville, Ky.

WILBERT J. HUFF, University of Maryland, College Park, Md.

WALTER G. WHITMAN, Massachusetts Institute of Technology, Cambridge, Mass.

GEORGE GRANGER BROWN, University of Michigan, Ann Arbor, Mich.

CHARLES A. MANN, University of Minnesota, Minneapolis, Minn.

JAMES R. LORAH, University of Missouri, Columbia, Mo.

HENRY J. MASSON, New York University, New York, N. Y..

CHESTER P. BAKER, Northeastern University, Boston, Mass.

JAMES R. WITHROW, Ohio State University, Columbus, Ohio

RICHARD L. HUNTINGTON, University of Oklahoma, Norman, Okla.

GEORGE W. GLEESON, Oregon State College, Corvallis, Ore.

DONALD S. CRYDER, Pennsylvania State College, State College, Pa.

MELVIN C. MOLSTAD, University of Pennsylvania, Philadelphia, Pa.

JAMES COULL, University of Pittsburgh, Pittsburgh, Pa.

DONALD F. OTHMER, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

JOSEPH C. ELGIN, Princeton University, Princeton, N. J.

JOHN L. BRAY, Purdue University, West Lafayette, Ind.

LEWIS S. COONLEY, Rensselaer Polytechnic Institute, Troy, N. Y.

ARTHUR J. HARTSOOK, The Rice Institute, Houston, Tex.

HOWARD S. GARDNER, University of Rochester, Rochester, N. Y.

CHARLES D. LUKE, Syracuse University, Syracuse, N. Y.

ROBERT M. BOARTS, University of Tennessee, Knoxville, Tenn.

EUGENE P. SCHOCH, University of Texas, Austin, Tex.

J. HENRY RUSHTON, University of Virginia, Charlottesville, Va.

FRANK C. VILBRANDT, Virginia Polytechnic Institute, Blacksburg, Va.

HENRY K. BENSON, University of Washington, Seattle, Wash.

OLAF A. HOUGEN, University of Wisconsin, Madison, Wis.

ERNEST D. WILSON, Worcester Polytechnic Institute, Worcester, Mass.

BARNETT F. DODGE, Yale University, New Haven, Conn.

AN AWARD

for

Chemical Engineering Achievement

to the

ATOMIC BOMB PROJECT

of the

MANHATTAN ENGINEER DISTRICT

CORPS OF ENGINEERS, U.S. ARMY

In recognition of its successful direction and administration of a great military and industrial accomplishment made possible by a patriotic pooling of the scientific knowledge and engineering experience of American industries and universities in the research and development, design, construction and operation of its vast manufacturing plants and facilities.

PRESENTED BY

CHEMICAL & METALLURGICAL ENGINEERING

FEBRUARY 26, 1946

For Their Research and Engineering

We Honor

WHEN the Committee of Award for Chemical Engineering Achievement voted unanimously to present the seventh of these biennial awards to the Atomic Bomb Project (See *Chem. & Met.* January 1946, pp.—), it was with the understanding that the Manhattan Engineer District of the War Department would share this recognition with those American industries and universities that had contributed most significantly to the research and engineering phases of this tremendous development. Because there were literally tens of thousands of companies, governmental agencies and educational institutions involved in the widespread activities of the Manhattan District, it was further agreed by the committee that the selection should be limited to those prime contractors whose work was concerned chiefly (1) with scientific research and development, including the supply of facilities and apparatus, as well as personnel, and (2) with the engineering functions of design, construction and operation of plants and laboratories, including the supply of special materials, equipment and facilities as well as of personnel and engineering services.

In helping the committee to select those prime contractors who meet the foregoing specifications, the officers in charge of the Manhattan District have pointed out that in case some qualifying company or university has been omitted inadvertently from the following list, that information should first be brought to the attention of the Secretary of the Committee of Award, Sidney D. Kirkpatrick, Room 2400, 330 West 42nd Street, New York 18, N. Y. His office will serve as a clearing house to receive any and all communications from companies and institutions that should have further consideration by the committee and the Manhattan District with the view to possible inclusion in a later list.

Subject to these rules of procedure established by the Award Committee and the Manhattan Engineer District, *Chemical & Metallurgical Engineering* is pleased to present the Seventh Award for Chemical Engineering Achievement to the following American companies and universities that contributed most significantly to the Atomic Bomb Project:

COMPANIES

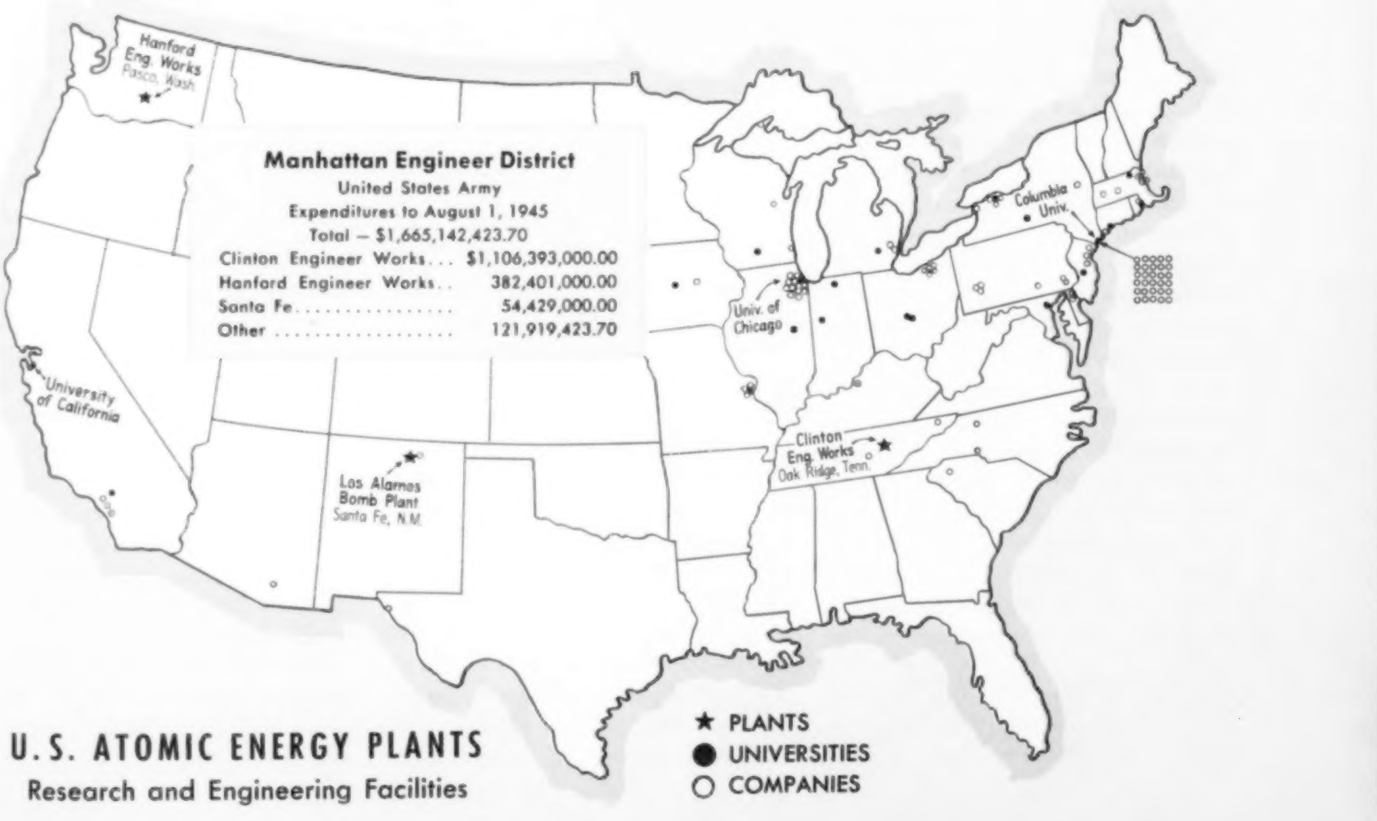
Allis-Chalmers Manufacturing Company, Milwaukee, Wis.
Aluminum Company of America, Pittsburgh, Pa.
American Cyanamid Company, New York, N. Y.
Babcock & Wilcox Company, New York, N. Y.
Bakelite Corporation, New York, N. Y.
E. B. Badger & Sons Company, Boston, Mass.
Bart Manufacturing Company, Belleville, N. J.
Baker & Company, Inc., Newark, N. J.
Beach-Russ Company, New York, N. Y.
Bell Telephone Laboratories, Inc., New York, N. Y.
Brush Beryllium Company, Cleveland, Ohio
Bryant Electric Company, High Point, N. C.
Calumet & Hecla Consolidated Copper Company, Calumet, Mich.
Carbide & Carbon Chemicals Corporation, New York, N. Y.
Chapman Valve Manufacturing Company, Indian Orchard, Mass.
Chrysler Corporation, Detroit, Mich.
Combustion Engineering Company, Inc., New York, N. Y.
L. K. Comstock & Company, Inc., New York, N. Y.
Cook Electric Company, Chicago, Ill.
Crane Company, Chicago, Ill.
Distillation Products, Inc., Rochester, N. Y.
Eastman Kodak Company, Rochester, N. Y. and Tennessee Eastman Corporation, Kingsport, Tenn.
E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.
Electro Metallurgical Company, New York, N. Y.
Fansteel Metallurgical Corporation, N. Chicago, Ill.
Fercleve Corporation and The H. K. Ferguson Company, Inc., Cleveland, Ohio
Fisher Governor Company, Marshalltown, Iowa
The Fluor Corporation, Ltd., Los Angeles, Calif.
Ford, Bacon & Davis, Inc., New York, N. Y.
Foster Wheeler Corporation, New York, N. Y.
Geo. A. Fuller Company, New York, N. Y.
Fulton Sylphon Company, Knoxville, Tenn.
General American Transportation Corporation, Chicago, Ill.
General Electric Company, Schenectady, N. Y.
The Girdler Corporation, Louisville, Ky.
Grayson Heat Control, Ltd., Lynwood, Calif.
Grinnell Corporation, Providence, R. I.
Handy & Harman, Inc., New York, N. Y.
Hanley & Company, Chicago, Ill.
Harshaw Chemical Company, Cleveland, Ohio
Hooker Electrochemical Company, Niagara Falls, N. Y.
Houdaille-Hershey Corporation, Detroit, Mich.
International Nickel Company, Inc., New York, N. Y.
Interchemical Corporation, New York, N. Y.
The C. O. Jelliff Manufacturing Corporation, Southport, Conn.
Johnson, Matthey & Company, Inc., New York, N. Y.
J. A. Jones Construction Company, Charlotte, N. C.
Kellex Corporation and The M. W. Kellogg Company, New York, N. Y.
Kinetic Chemicals, Inc., Wilmington, Del.
W. C. Kruger, Inc., Santa Fe, N. M.
The Linde Air Products Company, New York, N. Y.
Link-Belt Company, Chicago, Ill.
Robert E. McKee, Inc., El Paso, Tex.
McGean Chemical Company, Cleveland, Ohio
Mallinckrodt Chemical Works, St. Louis, Mo.
Metal Hydrides, Inc., Beverly, Mass.
Metals Disintegrating Company, Elizabeth, N. J.
Midwest Piping & Supply Company, Inc., St. Louis, Mo.
Monsanto Chemical Company, St. Louis, Mo.
National Carbon Company, Inc., New York, N. Y.
National Research Corporation, Boston, Mass.
Norton Company, Worcester, Mass.
Pacific Pump Works, Huntington Park, Calif.
Pennsylvania Salt Manufacturing Company, Philadelphia, Pa.
Phelps Dodge Copper Products Company, New York, N. Y.
Poe Piping & Heating Company, Greenville, S. C.
William A. Pope Company, Chicago, Ill.
Process Engineering, Inc., Somerville, Mass.
Revere Copper & Brass, Inc., New York, N. Y.
Roane-Anderson Company and Turner Construction Company, New York, N. Y.
Sargent & Lundy, Chicago, Ill.
A. S. Schulman Electrical Company, Chicago, Ill.
Singmaster & Breyer, New York, N. Y.
The Sharples Corporation, Philadelphia, Pa.
Skidmore, Owings & Merrill, Chicago, Ill.
Standard Oil Company (N.J.), New York, N. Y.
Standard Oil Company of Indiana, Chicago, Ill.
Stone & Webster Engineering Corporation, New York, N. Y.
M. M. Sundt Construction Company, Tucson, Ariz.
Taylor Instrument Companies, Rochester, N. Y.

Contributions to the Atomic Bomb Project These American Companies and Universities

U. S. Metals Refining Company, New York, N. Y.
United States Vanadium Corporation, New York, N. Y.
Valley Iron Works Company, Appleton, Wis.
Vanadium Corporation of America, New York, N. Y.
Vascoloy-Ramet Corporation, N. Chicago, Ill.
Victoreen Instrument Company, Cleveland, Ohio
The Vitro Manufacturing Company, Pittsburgh, Pa.
Watson-Flagg Engineering Company, New York, N. Y.
Western Electric Company, New York, N. Y.
Westinghouse Electric Corporation, Pittsburgh, Pa.
Whitehead Metal Products Company, Inc., New York, N. Y.
York Corporation, York, Pa.

UNIVERSITIES AND RESEARCH ORGANIZATIONS

Battelle Memorial Institute, Columbus, Ohio
Brown University, Providence, R. I.
California Institute of Technology, Pasadena, Calif.
University of California, Berkeley, Calif.
University of Chicago, Chicago, Ill.
Columbia University, New York, N. Y.
Cornell University, Ithaca, N. Y.
University of Illinois, Urbana, Ill.
Iowa State College, Ames, Iowa
The Johns-Hopkins University, Baltimore, Md.
Massachusetts Institute of Technology, Cambridge, Mass.
University of Michigan, Ann Arbor, Mich.
University of Notre Dame, South Bend, Ind.
Ohio State University, Columbus, Ohio
Princeton University, Princeton, N. J.
Purdue University, West Lafayette, Ind.
University of Rochester, Rochester, N. Y.
Washington University, St. Louis, Mo.
University of Wisconsin, Madison, Wis.
Yale University, New Haven, Conn.



The Role of

THE PROCESS ENGINEER

In The

Atomic Bomb Project

By P. C. KEITH*

After completing his undergraduate work at Austin, in his native state of Texas, P. C. Keith went to Cambridge for three years of graduate work in chemical engineering at the Massachusetts Institute of Technology. For many years he served as vice president of The M. W. Kellogg Company in charge of engineering and research.

Immediately after our entry into World War II, Mr. Keith was appointed to the Planning Board of Section S-1 of the Office of Scientific Research and Development, the forerunner of the Manhattan District responsible for the technical and engineering aspects as well as the production program for the atomic bomb project. Later in 1942 he was transferred to the special Kellogg subsidiary, The Kellex Corporation, to serve as its vice president and technical director, responsible for the Oak Ridge gas diffusion plant. He remained with Kellex until the two atomic bombs dropped on Japan signalized the success of the project. Now as president of Hydrocarbon Research, Inc., he devotes his great energy to the further development of a process for converting natural gas to motor fuels.—Editor.

SUCCESSFUL DEVELOPMENT of the atomic bomb project was the result of the joint efforts of a giant team—the physicist, the chemist, the engineer, and the industrialist—with the military calling the signals. Under the telescoped time schedule of the war emergency, these men were compelled to work closely together, whether they liked it or not—and they did not always like it. So close was their association that it was not uncommon to hear an eminent physicist expounding on the merits of different types of welding rod, or a prominent engineer glibly discussing nuclear physics.

The engineer and the industrialist would have been helpless without the fundamental scientific principles established by the physicist and the chemist, but in terms of the number of men involved, the scope of the problems encountered, the monies expended, the atomic bomb was predominantly the achievement of the engineer and the industrialist. Together they made the difference between success in this country and failure in Europe. The same engineering and industrial know-how which enables the United States to produce 100,000 airplanes or 2,500,000 automobiles a year is the true secret of the atom bomb.

Three processes were developed for the separation of uranium 235 from its isotope, uranium 238, and one for the synthesis of plutonium. Full scale plants to carry out all four processes were built and successfully operated. The three methods of separation of uranium 235 were: (1) The electromagnetic method, (2) the thermal liquid diffusion method, and (3) the gaseous diffusion method. A fourth process based on the use of centrifuges was studied and later abandoned. Diagrams illustrating the fundamental principles involved in these processes are shown in Fig. 1. Plutonium was synthesized in the chain-reacting pile by a process shown schematically in Fig. 2.

One can only begin to comprehend the difficulties of the engineer when they are related to single integrated developments. To touch upon

*In collaboration with the following members of the senior staff of the Kellex Corp.: J. H. Arnold, M. Benedict, O. C. Brewster, Z. G. Deutsch, H. M. Elsey, A. J. Fruit, J. C. Hobbs, J. F. Hogerton, C. A. Johnson, R. E. Powers, H. A. Rose, R. Rosen, L. Skog and J. S. Swearingen.

the highlights of all developments would lead to an inordinately long report and would not accomplish the main objective of this paper; namely, to indicate the role of the engineer in relation to the physicist and the chemist. Therefore, the subject matter has been limited to the

History in the making: December 1941—the Office of Scientific Research and Development organized the Planning Board to conduct the first studies on the technical, engineering and procurement aspects of both experimental and full-size plants for separating uranium isotopes. December 1942—decision made to proceed with engineering and construction of the full scale gaseous diffusion plant. June 1943—ground broken for power plant. September 1943—ground broken for first process building. April 1944—first turbine placed in operation. February 1945—first diffusional equipment operated on uranium hexafluoride. April 1945—first enriched uranium 235 produced. August 1945—atomic bombs dropped on Japan!

work of the engineers of the gaseous diffusion plant from the early days of 1942 to the completion and successful operation of the Oak Ridge works. The author wishes to emphasize that the selection of the gaseous diffusion process was made solely because of his greater familiarity with it, and not because it necessarily represents the greatest achievement or the most interesting story. One has only to read the Smyth report (See *Chem. & Met.* Sept. 1945, pp. 102-6.) to realize the stupendous coordinated effort behind each of the processes. Furthermore, the development and manufacture of the bomb itself, as yet an untold story, was a magnificent engineering feat.

Problems in All Processes

It might be of interest to indicate some of the more pressing engineering problems associated with the development of the other three methods, before entering into a more detailed discussion of the gas diffusion project.

Problems which had to be solved in the development of a successful pile were: (1) The control of the highly exothermic reaction, including the removal of heat from the reaction zone as rapidly as generated in order to prevent the reaction from getting out of hand, (2) enclosing the uranium in hermetically sealed aluminum jackets to prevent its corrosion, (3) protection of personnel from radioactivity, (4) disposition of radioactive byproducts, and (5) erection of a fantastic chemical plant remotely controlled to recover small amounts of plutonium from large quantities of uranium and other contaminants.

The engineer concerned with the electromagnetic method had to solve, among others, the following problems: (1) Fabrication of giant electrical magnets, (2) manipulation of a highly corrosive gas at high temperatures, (3) construction of a vacuum-tight system, the components of which had to be isolated and periodically dismantled for servicing and for recovery of uranium deposits, and (4) development of a batch-chemical process to handle thousands of gallons of solutions without significant loss of uranium.

The thermal diffusion engineer was beset with the problems of: (1) Handling a highly corrosive liquid at high temperature and high pressure, (2) building diffusion tubes with extremely low dimensional tolerances, (3) maintaining a temperature gradient from high-pressure steam on one side to cold water on the other and with only a few millimeters distance between the two mediums, (4) intermittent feeding and withdrawal of products without disturbing the quiet liquids within the diffusion tubes, and many others.

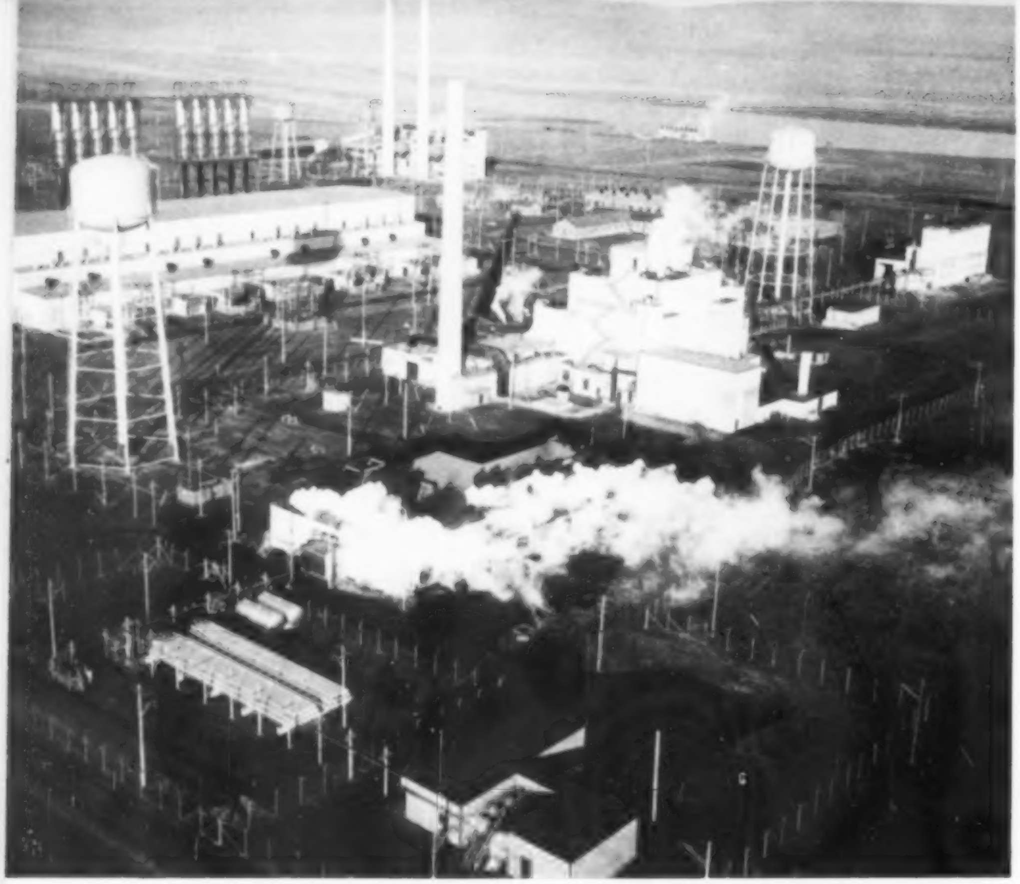
Principles of Gaseous Diffusion

Everyone remembers enough of his elementary physics to recall that the molecules of a gas move about in random fashion, and the average kinetic energy of the molecules is a constant. That is, $\frac{1}{2}mu^2=K$; in which "m" is the mass of the molecule, "u" is the average velocity, and "K" is a constant. Obviously then, if two gases have different molecular weights, i.e., different masses, the *average velocity* of the heavier gas is less than the average velocity of the lighter gas. Note that the reference is to the "average

The development of the atomic bomb was a national undertaking, a job requiring the best scientists of our leading universities, the know-how of industrial laboratories and engineering management, the technical skills of American workers and the military and engineering knowledge of the armed services. In short, the successful use of atomic energy is an extraordinary American achievement. This task force of scientists, industrialists and workers, the most brilliant ever assembled on any one project in the history of war or peace, won its objective in record time against continuously heavy odds.

Major General Leslie R. Groves
Manhattan Project Officer in Charge

The author, Mr. P. C. Keith, in the company of Major General Leslie R. Groves, commanding general in charge of the Atomic Bomb Project.



One of the seven major plants at Hanford for producing plutonium from uranium.

Hanford Engineer Works

Built on a 400,000 acre site in 1½ years by 45,000 construction workers at a cost of $342,000,000. Designed, constructed and operated by E. I. duPont de Nemours & Co. under prime contract with the Corps of Engineers for a total fee of $1. Required excavation of 25,000,000 cu.yd. of earth, construction of 386 miles of highways, 158 miles of railroads, 780,000 cu.yd. of concrete — practically all for buildings. A separate city of 2,500 houses, 45 dormitories, stores, churches and schools were built to accommodate the permanent operating staff of approximately 5,500 men and women.

velocity," since some molecules of the heavier gas may have a speed equal to or greater than the average speed of the molecules of the lighter gas, and conversely some molecules of the lighter gas may have slower speeds than the average speed of the heavier gas. The fact that the average kinetic energy of all gas is a constant makes possible the separation of gases of different mass by diffusion.

Observe the formula $\frac{1}{2}mu^2$ a little more closely. Assume two gases, one with a mass m_1 and velocity u_1, the other with a mass m_2 and velocity u_2. Then:

$$\tfrac{1}{2}m_1u_1^2 = \tfrac{1}{2}m_2u_2^2 \text{ or } \frac{u_1}{u_2} = \sqrt{\frac{m_2}{m_1}}$$

Thus the average velocities of the molecules of the two gases are inversely proportional to the square roots of their molecular weights. Now consider for the moment a mixture of two gases confined in a vessel. The molecules of each species in their random motion will collide with the walls of the vessel at rates inversely proportional to the square root of their masses.

As a specific example, let us consider a mixture of hydrogen and methane — one with a molecular weight of 2 and the other with a molecular weight of 16; then,

$$\frac{uH_2}{uCH_4} = \sqrt{\frac{16}{2}} = 2.8$$

or, the hydrogen molecules in an equimolal mixture would strike the walls of a container 2.8 times as often as the CH_4 molecules.

From this it is apparent that if the walls of the container were porous and the holes were just big enough to allow the gases to flow through molecule by molecule, the gas first diffusing through the container would contain 73 percent of hydrogen and 27 percent of methane. Obviously, this increased concentration of hydrogen would persist only for the first gas diffusing, and as the concentration of hydrogen relative to methane in the container decreases, proportionately more and more methane diffuses through.

Imagine, however, a system in which the depleted gas in the container is constantly being replenished by fresh gas of the original composi-

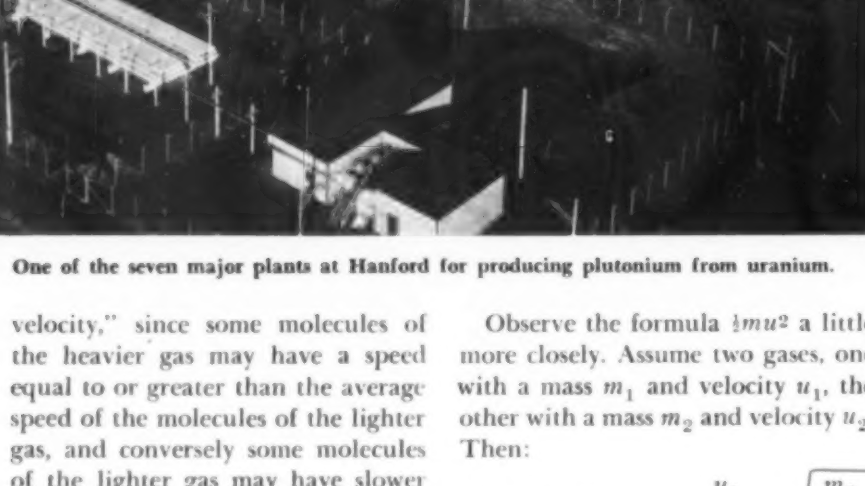


Fig. 1. All methods of separating Uranium 235 from Uranium 238 increase the proportion of U-235 only slightly, thus requiring an enormous number of cycles to achieve useable concentrations of the lighter of the two isotopes.

tion, thus maintaining an equimolal concentration within the container, and only a minute fraction of the gas is allowed to diffuse. Then the gas diffusing continuously would contain 73 percent hydrogen.

Unfortunately, this theoretical enrichment can never be realized in practice. First, there is always some back diffusion, i.e., the gas on the outside of the vessel diffusing back into the vessel; second, the theoretical enrichment holds only for true effusive flow (i.e., molecule by molecule) and in every instance some mass flow occurs, since in all known screens some of the holes are too large for effusive flow; third, there exists at the container wall a sluggish gas film. It is from this film that diffusion occurs, and a certain amount of hydrogen impoverishment within the film is inevitable. However, by proper design, it is possible to reduce the sum of these inefficiencies to a tolerable figure and thereby to realize a significant enrichment of lighter gas in the diffused fraction.

Perhaps the greatest cooperation recorded in history was evidenced by the scientists, engineers, construction men, operations managers and workers in the plants—the people whose skill, know-how, dogged determination and teamwork made the atomic bomb possible.
Col. KENNETH D. NICHOLS
District Engineer
Manhattan Engineer District

Now, it is apparent that if a portion of the diffused gas from the first separation is allowed to diffuse through a second barrier, a further enrichment will be realized. The gas in the container will average 73 percent hydrogen and 27 percent methane, and hydrogen will now diffuse at a faster rate, not only because of the higher average speed of its molecules, but also because of the relatively larger number of hydrogen molecules. To sum up: in a system with true diffusive flow, the rates of diffusion of two gases through an ideal barrier are proportional to their respective partial pressures and

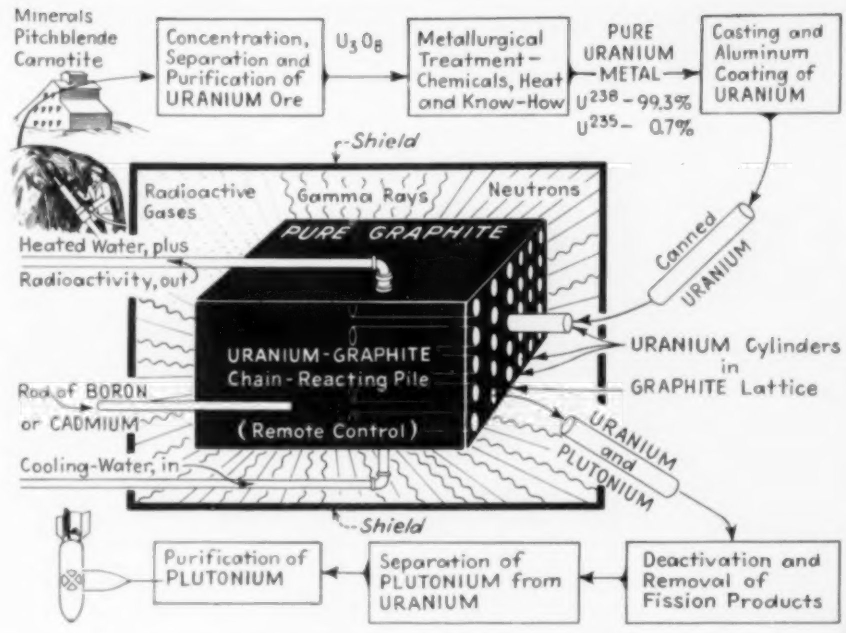


Fig. 2. Uranium metal is prepared from the ore by the steps indicated above, is then welded into aluminum cans and placed in the uranium-graphite chain reacting pile. Nuclear bombardment produces a small proportion of plutonium which must be separated chemically from the uranium and fission products to yield the active ingredient for an atomic bomb. (Courtesy, American Petroleum Institute.)

inversely proportional to the square roots of their molecular weights.

The foregoing discussion is applicable only to gases. The problem of the engineer in the diffusion plant was the separation of two isotopes of uranium, the heaviest of the natural metals. It was therefore necessary to convert it into a volatile, stable derivative. An exhaustive investigation of uranium derivatives disclosed only one compound combining stability and volatility in the degree required. It was the salt, uranium hexafluoride.

The molecular weight of $U_{238}F_6$ is 352 and that of the U_{235} isotope, 349. Hence, the ideal separation factor is

$$\sqrt{\frac{352}{349}} = 1.0043$$

It has already been shown that to realize this ideal separation factor, the gas diffusion is restricted to a small fraction of the total. Mathematical studies showed that the most desirable condition from the point of view of plant size and power requirement would be a stage where one-half the gas diffused through a barrier and the circulation through any diffusion stage would be many times the net transport of material from stage to stage. This requirement reduced the enrichment factor from a theoretical 1.0043 to 1.0030. Added to this reduction in enrichment was the further reduction due to the presence of some larger holes in the barrier, inadequate mixing of gases in the stage, and back diffusion.

The engineer will appreciate the difficulty in designing a distillation process with a relative volatility less than 1.0043. The difficulties were even more formidable in the diffusion process, for which there was no engineering precedent. Calculations indicated that if a reasonable enrichment per diffusional stage were assumed, over 4,000 stages would be required to take the concentration of $U_{235}F_6$ from 0.7 percent, which is the concentration of U_{235} in natural uranium metal, to 99 percent. Imagine a continuous bubble column of 4,000 plates with vapor feed and overflow being pumped to each plate, and you begin to get an idea of the complexities of a gaseous diffusion plant!

Dr. Jekyll-Mr. Hyde

Fortunately, fluorine, the acidic component of uranium hexafluoride, has no isotopes, and in this respect,

Here, magnified several times, is a test tube containing 20 micrograms of pure plutonium hydroxide that was made at University of Chicago's "Metallurgical Laboratory."

it was ideal for use in the diffusion process. Also, the hexafluoride is thermodynamically stable up to relatively high temperatures, again making it ideal for use in the diffusion plant. However, it may be conservatively stated that in no other respect was the hexafluoride ideal. On the contrary, it was about as far from ideal as possible and still useable. Its many adverse characteristics were to dictate much of the unique and novel engineering which found its way into the diffusion plant.

Among other things, the hexafluoride: (1) Sublimes without liquefying at atmospheric pressures at 56° C. or 130° F.; (2) reacts at elevated temperatures with almost all chemicals except nitrogen, rare gases, saturated fluorides and fluorine; and (3) reacts at moderate temperatures with water, organic substances, glass and metal to form non-volatile solids which tend to deposit within the plant and are then recoverable only by chemical treatment of the internal surfaces.

The extreme reactivity or corrosive nature of uranium hexafluoride was particularly serious because of the vast internal surfaces of the plant and because the size of the holes in the barrier had to be maintained constant. In the first instance, a corrosion rate well below the tolerances for indefinite retention of mechanical strength could still be sufficient to convert all the 235 isotope into non-volatile compounds and thereby completely stop production. In the second instance, opening up or closing of the holes of the barrier could reduce the separation to only a fraction of that required. As a result it was necessary to treat chemically all internal surfaces of the diffusion plant until the average corrosion rate was of the same order as stainless steel in air.

The properties of the uranium hexafluoride defined the general outline of the plant. It would have to operate: (1) At relatively low temperature and hence under vacuum; (2) at relatively constant temperature to prevent solidification of the process gas; (3) in an atmosphere dried to −40° F. dew point; (4) with a control system sensitive enough to prevent pressure waves from propagating through the system and mixing gases of varying degrees of enrichment; and (5) with a system sufficiently tight to prevent inleaking of air blanketing the upper stages of the cascade.

An Analogy to Distillation

It should now be obvious that the production of high-purity products by gaseous diffusion, just as by fractional distillation, requires a series of separations or steps. In fractional distillation the apparatus to carry out one step is called a tray or plate, in gaseous diffusion, a stage. The assembly of trays in distillation is generally known as the column; in gas diffusion, the assembly of stages is termed the cascade.

The Stage—The basic unit of the diffusion plant is the stage. The feed to a stage is compressed by the first pump and flows through the high pressure side of the diffuser. Part of the gas passes through the barrier, and is enriched in light component. The other part of the gas remains undiffused and is depleted in light component. The undiffused gas flows through a valve, which controls the diffuser pressure, to the next leaner stage. The diffused gas is partially compressed by another pump and advanced to the next richer stage.

The Cascade—Because of the extremely low separation factor, it is necessary to use a cascade of thousands of stages to secure the desired degree of separation.

The schematic resemblance to a distilling column will be obvious. Diffused gas takes the place of vapor, and undiffused gas, of liquid. Uranium 235 hexafluoride is the overhead (product) and uranium 238 hexafluoride is the bottoms (waste). Like the distillation column, the cascade contains an enriching and a stripping section.

For economy of materials and power consumption, several stage sizes are used in the cascade, the largest ones near the feed point and smaller ones at the product and waste ends.

Auxiliaries—In addition to the cascade proper, a diffusion plant requires the following essential auxiliaries: (1) A feed unit to prepare and introduce feed to the cascade. (2) Product and waste withdrawal units, to remove these streams from the cascade. (3) A surge system, to cushion accidental variations in cascade inventory. (4) A purging system continuously to separate and remove air and other foreign gases leaking into the cascade. (5) A source of the

enormous amount of dependable, steady power required for thousands of stage pumps. (6) A cooling system, to remove the heat of compression into which the electric power is converted.

Problems of Process Design

The first industrial application of gaseous diffusion gave rise to a number of unusual process design problems. Among the more important were the selection of the number and size of stages, the design of the cascades, process control and the prevention of contamination. These will be discussed in this order.

Number and Size of Stages—In the usual engineering project, the designer is able to draw on established operating experience and rules-of-thumb in sizing equipment and setting safety factors. The less fortunate engineers in the diffusion plant were totally without support of this kind. How could there be operating experience with a process never attempted on a commercial scale? How could there be rules-of-thumb in a design project unlike any previously undertaken?

Nevertheless, it was necessary to formulate characteristics of pumps, diffusers, and other hypothetical equipment, and to set up a wholly arbitrary cost structure and other design criteria to answer the following types of question:

(a) How many sizes of equipment should be used?

(b) Is it better to use a large number of small stages, or a smaller number of larger stages?

(c) Is it better to use a large area of high quality, low permeability barrier, or a smaller area of barrier of higher permeability?

(d) Is it better to use a large number of pumps with low compression ratio, or a smaller number of pumps with higher compression ratio?

(e) Is it better to operate at high pressures with high separation capacity and large holdup of uranium, or is it better to operate at lower pressure?

These were engineering problems, and they were solved as all other difficult engineering problems have been solved. The few data available were collected. All possible valid conclusions were drawn from these data. Essential missing information was supplied by educated guesses. Engineering judgment was used in setting up consistent design principles. From data, conclusions, guesses and principles, decisions were made.

Cascade Design—The physical layout of several thousand stages and the manner of connecting these stages into an operable cascade gave rise to many novel engineering problems. Should the stages be laid out in a single line, on a single level, or in three dimensions? How many stages should be operated as a single unit? What provision should be made for the isolation of a group of stages in the event of an accident, without interruption to operation of the balance of the cascade? What spare equipment should be provided, so that any part of the plant could be repaired without interference with operation of the rest of the plant? Solutions to these problems required engineering judgment of a high order.

Process Control — Control of the operation of several thousand interdependent stages presented many novel engineering problems. The most important of these was control of pressures on each of the stages of the plant. Without adequate control, pressure waves would have developed which would have overloaded pumps and mixed partially separated isotopes, thus nullifying some of the separation performed by the cascade. Because of the large number of stages, this problem was without precedent in the history of process control. Since there was no opportunity to experiment with the control of diffusion stages before design of the control mechanism, it was necessary to make a theoretical analysis of the hydrodynamics of the thousand-stage plant and to specify devices which this analysis predicted would lead to stable control. When the plant was brought onstream, these control devices functioned perfectly, thus testifying to the successful solution of a most difficult and abstract engineering problem.

All the pure uranium available to scientists at the outset of the bomb project was made in this laboratory set-up at the Westinghouse Lamp Division in Bloomfield, N. J.

Contamination — Because the diffusion plant is operated below atmospheric pressure, the process is complicated by the presence of contaminants such as air and other substances capable of leaking into the plant. If not detected and purged from the process, these contaminants would so dilute the uranium hexafluoride as to render the process inoperable. Engineering problems concerning contaminants which confronted the designers of the plant are illustrated by these questions:

(a) At what rate will contaminants leak into the process?

(b) How shall contaminants be purged from the plant?

(c) How fast will contaminants move through the plant?

(d) What instruments shall be used to measure contaminant concentrations?

(e) How shall contaminant leakage be located and prevented from affecting the entire plant?

The principal building of the gaseous diffusion plant is a "U", 2,500 ft. on a side, 400 ft. wide, 4 stories high. It houses the largest, continuous chemico-physical process in the world.

The successful solution of these engineering problems contributed in no small measure to the success of the plant. Through a combination of good judgment in setting tightness specifications and strict control of all manufacturing and assembly operations, the leak rate of contaminants has been kept below that assumed in design. The purging equipment has been adequate to prevent build-up of contaminants in the plant. The motion of contaminants in the process was correctly predicted by theoretical engineering analysis. Novel instruments were developed to detect and locate the source of incipient leaks, and a central control room like the damage control center of a battleship was provided for prompt action in isolating a severe leak. These are all remarkable engineering achievements. Although several severe leaks have occurred, they have been quickly detected, located and isolated and the contaminant purged without serious effect on plant operations.

Barrier and Diffuser

The barrier is the heart of the diffusion plant. It is a porous sheet in which the size of the pores is so small that the bulk of the flow through them is by effusion, or molecule by molecule, in contradistinction to the non-separative mass flow which results with larger holes.

The process design of the plant was completed before a satisfactory barrier had been developed, and so the barrier engineer was faced with the problem of producing a real barrier using a hypothesis as a pattern. This barrier had to have a minimum separating efficiency; otherwise the number of stages required to produce the specified purity would have been inordinately high. It had to be sufficiently stable so that reaction between its surface and the hexafluoride would not result in the conversion of a significant fraction of the hexafluoride to non-volatile salts. It required other characteristics to obviate serious loss of separating efficiency.

Furthermore, the barrier had to possess the proper mechanical properties to allow its fabrication in forms suitable for assembly into diffuser units.

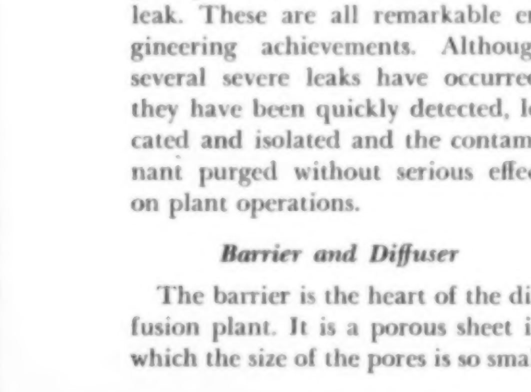
With its hypothetical pattern and stringent requirements, the diffusion barrier was to elude a large and talented group of scientists and engineers for almost three years. During the greater part of this time, the success of the barrier development and the success of the diffusion plant were synonymous.

Given a barrier, it is then necessary to design holders or diffusers to support in suitable geometric form the large number of square feet required for each stage. Whereas the fundamentals of the design of the diffuser were available once the process design was settled, the engineer was confronted with the problem of developing a contraption without knowing the mechanical properties of the main element.

The problem of disposing so many square feet of surface within a small volume taxed the ingenuity of a large group of mechanical engineers. To arrive at a design which was at once satisfactory process-wise, mechanically sound, and amenable to volume production, was no easy task. A number of strange looking units resulted. The one finally installed in the plant was chosen because it represented the nearest approach to equipment which had already been manufactured in volume by American industry.

Again, the manufacture of diffusers was hardly attractive business for the overworked industrialist. Nevertheless, the Chrysler Corporation agreed to undertake it. While patiently awaiting the solution of the barrier development, they tooled up an efficient assembly line and manufactured some of the parts. They also studied the mechanical properties of available specimens of barrier, devised methods of fabricating the barrier into a gas-tight sub-assembly, and carried on extensive research and development along related lines. As a result, when the barrier was finally available, they were able to turn out diffuser units in record time. It may now be revealed, to their credit and the credit of the engineers at the plant site, that all but two of the thousands of units manufactured for installation at the plant site were actually installed and operated.

Placed inside these diffuser units were the gas coolers to remove the heat of compression. These coolers had to be corrosion resistant, possess a large amount of gas cooling surface



Here on December 2, 1942, under the West Stands of Stagg Field at the University of Chicago was put into successful operation the first nuclear chain reacting uranium pile.

per foot of length, and be absolutely tight. Their geometrical arrangement was weird. Wolverine Tube Division of The Calumet and Hecla Consolidated Copper Co. took on this job. They knew that once the cooler was installed, it had to be installed "for keeps." To remove it would require the destruction of a stage and the interruption of the cascade. Of the thousands of coolers they made, only two have been even suspected of "weeping."

Pumps and Pump Seals

The diffusion plant requires pumps and pump seals for a variety of services. Some of these pumps are revolutionary in design and perform novel tasks. Others are conventional models for routine service. Several of the more interesting machines are worth describing in some detail.

Process Pumps – The most important pump in the diffusion plant, and the most unusual, is the process pump. It is an essential part of each stage. It has two functions: to circulate the uranium hexafluoride throughout the cascade and to maintain a pressure drop across the barrier.

The large volumes of gas which must be handled by the process pumps indicated that a centrifugal compressor should be used for this service. Also to be considered, however, were the high compression ratio, the sub-atmospheric pressure operation, the low corrosion tolerance, and the small displacement volume, all set by the process design. Exploratory studies were made of every conceivable type of pump. All appeared to have serious disadvantages. It was not until it had actually been demonstrated that a centrifugal pump could be made to operate efficiently with high speeds that the eventual solution of the pump problem could be foreseen. Even then, it seemed almost inconceivable that a shaft seal for such a unit could be manufactured which would keep leakage down to a tolerable figure.

After more than two years of the most intensive development work by a group of recognized leaders in their field, a combination pump seal and drive was designed. Once more an American manufacturer was asked to convert some wild ideas into rugged, dependable machines. This time it was Allis-Chalmers Manufacturing Co. who came to the rescue. By almost superhuman effort, they were able to manufacture pumps by the thousands and in accordance with a tight time schedule. Vacuum tight, built of special corrosion-resistant materials, and equipped with a suitable shaft seal, this pump is one of the greatest mechanical engineering achievements of the project. A tribute to its designers is the fact that to date the maintenance has only been a fraction of what had been anticipated and what had been considered tolerable.

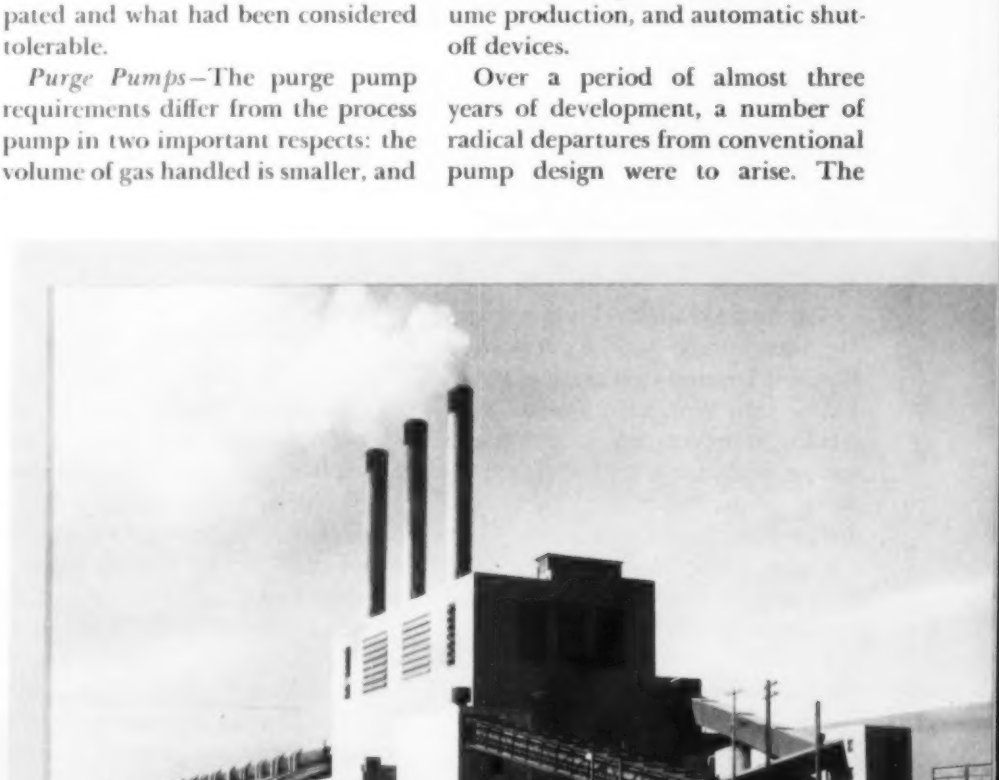
Welding by the Mile

Here's the record on welding in the gas diffusion plant: Total welding machines in simultaneous operation, 1,200. *Total length of welding: arc welding* 400 *miles, atomic hydrogen welding* 100 *miles, air-tight welding on cell enclosures,* 1,100 *miles.*

Purge Pumps–The purge pump requirements differ from the process pump in two important respects: the volume of gas handled is smaller, and the material pumped varies in composition from essentially pure uranium hexafluoride to essentially pure air. One purge pump is required for each stage of the auxiliary diffusion cascade used to purge light gases from the plant.

The small quantity of gas to be handled and the fact that some of the pumps have to compress low molecular weight gases made the use of centrifugal machines particularly unattractive. Either the tip speed would have to be increased out of proportion to what was believed possible or a large number of stages would be required. The obvious solution was a reciprocating pump, but it was not without serious disadvantages. None of the known lubricants could be used in contact with the uranium hexafluoride vapors inside the cylinder, the seal between the piston rod and the cylinder had to be essentially gas tight, the volumetric displacement had to be small, and the mechanical efficiency high. These special requirements were in addition to those common to all diffusional equipment; i.e., rugged, dependable construction for continuous service, high corrosion resistance, vacuum tight construction, designs amenable to volume production, and automatic shutoff devices.

Over a period of almost three years of development, a number of radical departures from conventional pump design were to arise. The



The largest steam plant ever constructed in one operation supplies 238,000 kw. of power and process steam for Clinton Engineer Works. Behind, the thermal diffusion plant.

A section of the plant for the electromagnetic separation of the isotopes of uranium. "Chemistry" building in the center.

names of some connote the extent of this departure: the shaker pump, the snake pump, the paddle pump, the magnetic pump. But again, as so often on this project, a modification of a tried and true machine was to win out. The only development to meet all process requirements was a single-stage valve-in-head reciprocating machine. It is a high speed pump with gas lubrication between piston and cylinder and a sylphon bellows seal between piston rod and cylinder.

Electromagnetic Plant

A gigantic plant consisting of 175 separate buildings, including nine major processing structures, was built at Oak Ridge by Stone and Webster Engineering Corp. at a total cost of $427,000,000. Tennessee Eastman Corp. collaborated in the design and on completion took over entire operating responsibility. Problems on specialized equipment were worked out jointly with Allis-Chalmers, Westinghouse and General Electric, as well as with many other manufacturers.

The first models of this reciprocating pump were built by American Machine Defense Corporation. Later, Valley Iron Works Co. was to make certain improvements in the design and to manufacture all units for installation at Oak Ridge. Valley also designed an ingenious type of piston rod seal which undoubtedly would have seen service had the bellows seal development failed.

Vacuum Pumps—Three types of vacuum pump had to be developed for the diffusion plant: a single-stage and a two-stage machine for handling corrosive chemicals and a high speed unit for pumping down equipment during vacuum testing operations. The first two had to meet all the unusual conditions demanded by the process: small displacement, high corrosion resistance, continuous operation, etc. The third had to be rugged, portable, and amenable to volume production. The F. J. Stokes Machine Co. and the Beach-Russ Co. developed and manufactured the machines for handling corrosive gases, meeting all plant specifications. The high speed evacuation pumps were developed and manufactured in quantity by Westinghouse Electric Corporation and National Research Corporation.

Coolant Pumps — Special coolant pumps were developed and manufactured in large numbers by the Pacific Pump Works. These were rotary pumps lubricated in a manner so as not to contaminate the coolant, and sealed so that the loss of coolant was negligible.

Valves and Piping

In terms of numbers and variety, the valve problem exceeded all others. Approximately one-half million valves are required to operate the diffusion plant. They vary in nominal size from 1/8 inch to 36 inches, and in type from conventional globe valves for water and air service to special units designed to the most rigorous specifications of cleanliness, corrosion resistance, and tightness. Two developments typical of many were the pressure control valves used to control pressure, and indirectly, flow, in the diffusion cascade, and process block valves used to isolate diffusional equipment.

An analogy can be drawn between the control of reflux from a tray of a fractionating tower and the control of flow from a stage of the diffusion cascade. In both instances, a device is required which will vary the flow from a tray or stage in conformity with the flow to the tray or stage and of itself will not set up a variation in flow. Any number of devices have proved satisfactory for control of flow from a tray of a fractionating tower, including a simple weir. However, the solution for the diffusion stage with gases moving in both directions, thousands of centrifugal compressors operating in series, and small changes in pressure level being reflected in equivalent changes in inventory, proved most complex.

An adequate solution to the control problem was found only after the most exhaustive theoretical analysis of the cascade by thirty-odd mathematicians experienced in the application of difference-differential equations to the solution of concrete problems. This time the engineer was faced with the problem of designing a valve with an automatic response defined by a mathematical equation which he could not fully comprehend; a valve that would operate dependably and could be manufactured by the thousand in short order. In the face of these conditions, such additional problems as vacuum tightness and corrosion resistance seemed like child's play.

By working in closest contact with the mathematicians, engineers of the Taylor Instrument Cos. and the Fisher Governor Co. developed one mechanism, saw wherein it was deficient, developed another, and so on until they finally succeeded in producing a controller which the mathematicians predicted would yield a stable plant. Operation of the plant has proved their predictions valid.

Block valves used to isolate sections of diffusional equipment had to meet the usual vacuum tightness and corrosion resistance specifications. In ad-

dition, they had so to be constructed that there would be essentially no possibility of failure of the vacuum seal during the operation of the valves. Also, the leakage across the seat had to be of an order of magnitude less than for the best valves previously built in quantity. A modification of the Hobbs double gate valve, incorporating special double bellows seals, proved satisfactory in all respects but seat leakage. After more than two years of development work, a resilient seating material was produced and combined with the modified Hobbs valve. The result proved to be a complete solution of the block valve problem. The Crane Co. set up an assembly line with cleaning and testing facilities, and manufactured these valves by the thousand, all in accordance with a most trying time schedule.

To the diffusion plant, piping is a necessary evil. An ideal cascade would be one without piping, fittings, or expansion joints. But unfortunately, a not inconsiderable amount of piping must be used in the practical cascade. Piping was made from straight lengths and slow bends, with as few fittings as possible. Expansion was taken care of by a specially designed joint which added essentially nothing to the internal volume of the piping.

One can begin to appreciate the magnitude of the job of assembling the miles of piping which went into the diffusion plant when one considers that each piece which was slated for exposure to uranium hexafluoride had to be fabricated of corrosion-resistant material and had to be made surgically clean before installation. It would have been desirable from the point of view of mechanical properties to use steel throughout, but unfortunately, steel had not been proved to be sufficiently corrosion resistant. Thus another compromise had to be made. Much of the piping had to be prefabricated, and welding techniques had to be developed to produce vacuum tight bonds. The greater part of the piping was fabricated by the Midwest Piping and Supply Company, Inc. Much of it was cleaned and vacuum tested before shipment to the plant site. The remainder was processed in a special shop set up by Midwest at Oak Ridge.

Thermal Diffusion Plant

To provide enriched feed for the electromagnetic process, the H. K. Ferguson Co., through its special subsidiary, Fercleve, designed, constructed and operated a $10,500,000 plant to use the thermal diffusion process developed in the Naval Research Laboratories. Some typical orders: forty-two 10,000 gpm. centrifugal pumps with 100 hp. motors, four 15,000 gpm. vertical turbine pumps with 700 hp. motors, 15,000 valves, 50 miles nickel and 20 miles iron pipe.

Vacuum Engineering

It was no small task to convert the diffusion plant into a vacuum tight system. The extremely large internal volume of the plant relative to its output required an assembly much tighter than conventional industrial vacuum equipment. Inleakage of air into the plant at what would ordinarily be considered a very low rate would have been sufficient to blanket the smaller top end of the cascade with light gases and seriously curtail, if not completely stop, production. Also, even though during operation all external surfaces of the plant are bathed in dry air, moisture accompanying such air would lead to an excessive conversion of uranium hexafluoride to non-volatile salts. Therefore, the plant had to be made extraordinarily tight.

An impression of the degree of tightness required can be gleaned from the fact that if the plant were evacuated, sealed and then allowed to stand in a non-corrosive atmosphere, few men reading this paper would live to see the vacuum completely broken.

With such strict specifications for vacuum tightness, it is obvious that the number of tolerable leaks after initial assembly had to be extremely small if the plant were ever to be made tight. It is also obvious that in view of the vast and intricate surfaces which had to be probed for leaks, revolutionary methods of leak detection had to be developed.

Among the methods of leak detection used in industry at the time the plant was designed were: (1) Pressure test, (2) use of a trace gas and an optical pyrometer, and (3) use of a trace gas and a differential Pirani gage. None had the sensitivity or flexibility required for the final testing of the diffusion plant. However, the pressure test did prove of inestimable benefit as a preliminary check on the first units installed at the plant site.

A laboratory method of detection of leaks using a probe gas and the Nier mass spectrometer had been developed at the University of Minnesota. The sensitivity of the method was many, many times that of any other known method, but the instrument was of delicate construction

S-50, the thermal diffusion plant at Oak Ridge and its small auxiliary power plant at the left.

and required technically trained operators. To apply this technique to the field, it was necessary first to convert this delicate laboratory unit into rugged equipment which could be bounced around in the field by semi-skilled operators, and then to manufacture such units in quantity. The General Electric Co. solved both problems in record time. Kellex engineers developed techniques for the rapid and accurate testing of large scale equipment and with the cooperation of Columbia University taught the art to over 300 young men. These men were to become known as the "snifter brigade" and to them goes a large share of the credit that is due for making the plant tight.

In order to obtain an initial assembly with as few leaks as possible, sub-assemblies were tested both at the plants of vendors and in the field before final installation. Castings were avoided wherever possible, and welded construction was used whenever practicable. By following these principles and by using bellows and diaphragm seals for all connections between the ambient and process streams, such as valve stems and actuating mechanisms, the equipment as first assembled was relatively tight. By applying the vacuum techniques outlined above, residual leaks were quickly located and repaired. Furthermore, the plant has continued to remain tight during operation.

Instruments by the Mile

Both in number and variety the instruments of the diffusion plant run valves a close second. Some are standard models used in conventional services, some are modifications of standard models meeting special requirements, and some are radical departures from conventional instrumentation.

Gaseous Diffusion Plant

K-25—the gaseous diffusion plant at Oak Ridge—has been described as "the largest continuous chemico-physical process in the world." With a total of 63 process buildings, sprawling over 600 acres and costing a half billion dollars, the project up to January 1, 1946, had required approximately 60,000 carloads of materials and equipment. Kellex, wartime subsidiary of the M. W. Kellogg Corporation, handled design, supervision of construction and procurement of equipment. Chief construction contractor was J. A. Jones Co. with Ford, Bacon and Davis, Inc., in charge of design, construction and preliminary operation of subsidiary plant to "condition" equipment. The entire operating responsibility is that of Carbide & Carbon Chemicals Corporation.

Special devices were developed for measurement and control of pressure, temperature and flow. All were designed so that parts within the process stream were sealed from external parts by means of diaphragms or bellows. They were also designed to give accurate and rapid response at remote stations. Other instruments were developed for analyzing the various gas streams for plant control and for assaying the product. Since instrument application, more than any other single detail, is descriptive of the process and engineering design and method of operation, details are still cloaked in secrecy, some still hiding behind such deceptive names as "line recorder" and "space recorder."

Most of the larger instrument companies in the country contributed to the diffusion plant. However, it was to the General Electric Co. and to Taylor Instrument Cos. that the Kellex Corp. turned for procurement of essentially all instruments. Between them, these companies developed sources and procured instruments in accordance with the previously determined master time schedule.

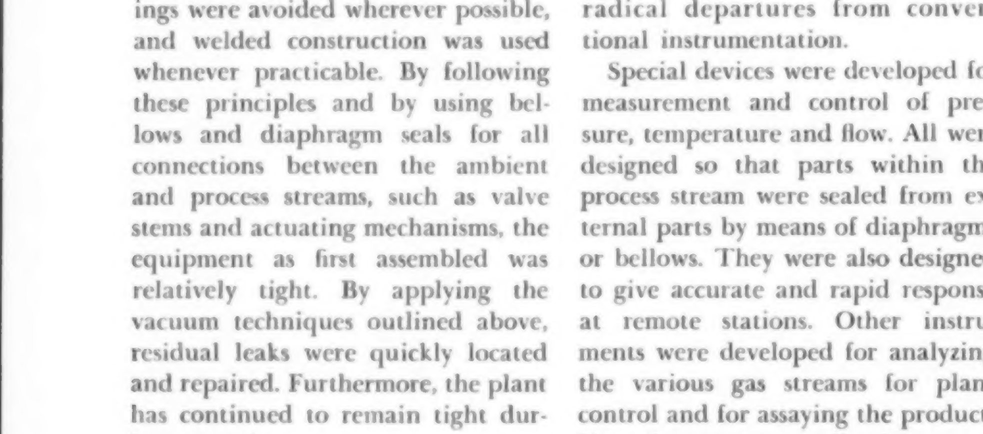
Special Chemicals

In addition to uranium hexafluoride, a number of special chemicals were required for operation of the diffusion plant. The majority of these were liquids which would be stable to uranium hexafluoride. Such liquids were used for coolants, lubricants, test fluids, etc., in place of more common liquids, whenever there was danger of their introduction into the system upon any kind of failure of equipment.

New compounds for all such duties were synthesized by E. I. du Pont de Nemours & Co., Harshaw Chemical Co., and Hooker Electrochemical Co. This phase of the work was under the direct supervision of the Manhattan District, with Kellex serving as consultant on plant requirements and specifications. Much of the development work was done at Columbia, Johns Hopkins, Ohio State, Purdue and Princeton Universities.

In conclusion, the author again asks the reader not to forget the men who contributed to the other plants, nor those who designed the bomb, who carried it to the Pacific, and who dropped it upon Hiroshima and Nagasaki. The author also wishes to emphasize the all-important role of the War Department, without whose coordinating services, encouragement, and aid, the bomb could not have been made.

☆ ☆ ☆



Liquid effluents from the plutonium plant at Pasco, Wash., are run into these huge storage tanks pending final disposition.

CHEMICAL ENGINEERING PROGRESS FOR PEACE

War's Most Promising Byproduct

Editorial Staff Reviews

What we have learned in war must now be applied in peace. For more than five years, production has been pushed to the limit of plant capacity. New products, improved processes and more efficient equipment have developed through war necessity. Our problem is to appraise the significance of these developments in order to project their application to peacetime problems.

Last month *Chem. & Met.* presented graphically a five-year inventory of chemicals and other raw materials to show where we stand in relation to the job ahead. This month the emphasis shifts to processes and equipment but again the purpose is to review wartime technical developments in order to promote a better understanding of peacetime applications.

In the pages that follow the editors of *Chem. & Met.* offer their appraisal of some of the trends of technological progress in the various process industries. A subsequent section deals with the parallel developments in process equipment. Both will be helpful in the job of translating the many wartime achievements of the process industries into "Chemical Engineering Progress for Peace."—S.D.K.

MINERAL ACIDS

FIVE years of war and the preparation for it produced no very marked changes in the methods of producing mineral acids, although outputs were enormously increased in most cases and a number of interesting improvements associated with acid use came into prominence. Sulphuric and nitric acid applications were largely extrapolations of earlier peacetime counterparts, but in the case of hydrofluoric and hydrochloric acids, these chemicals emerged in new uses, both as catalysts and as reactants, that may prove as important for the future as they were in the war years just past.

Sulphuric Acid—The spectacular rise of this capstone chemical to an annual output topping 9,000,000 tons on a 100 percent basis in both 1944 and 1945 has already been detailed in our January issue. It was pointed out that there were no insuperable dislocations of supply and that the vast increase in demand was met with a minimum of difficulty through the building of new facilities, the addition of oleum towers and concentrators at existing plants, and the pushing of many plants to operating rates well above their nominal capacities. On the raw material side it was explained how reductions in the available pyrites supply were much more than offset by the ability of the sulphur industry not only to provide for all needs but also to keep a year ahead of the demand in its stocks above ground.

During the war years there was not a great deal of variation in the quantity of acid produced from byproduct sources, although such a source came into operation for the production of elemental sulphur. This method, employing the Girbotol process to strip hydrogen sulphide from the sour gas in a southern oil field, was examined on a pilot plant scale by the Texas Gulf Sulphur Co. and later exploited commercially by a somewhat similar method by the Southern Acid & Sulphur Co. The stripped H_2S is believed to be treated in a modification of the old Claus kiln and oxidized to water and sulphur. The process is currently reported to be operating successfully at a rate considerably over 50 tons of sulphur per day. Aside from the small elemental sulphur recovery at fuel gas plants by processes such as the Thylox, this is the only present sulphur recovery operation in North America. Again, however, Southern Acid is reported to be planning a similar operation at another field. The Consolidated Mining & Smelting plant at Trail, B. C., has been diverting its available SO_2 entirely to acid and ammonium sulphate during the latter war years and has not been operating its sulphur recovery plant recently. Some question is understood to exist as to its future status.

Innovations in wartime acid plant construction were mostly in matters of detail. New plants were built chiefly to employ the vanadium contact catalyst, although a sizable number of Mills-Packard chambers were constructed, having an aggregate daily capacity of 530 tons of 50 deg. acid. These were employed in two new chamber plants; as means for the expansion of box chamber plants; and as replacements for worn-out box chambers. Such chambers are virtually the only type now considered for new chamber plant construction in the United States and it is reported that an aggregate capacity of 170 daily tons (50 deg.) is at present under construction or contract.

Incidently, instances have been noted where the operators of conventional box chambers have attempted, how successfully

is not known, to secure one of the benefits of the Mills-Packard system by adding external water cooling of the chamber walls.

One interesting trend in contact plant construction was toward the use of "outdoor type" plants, similar to the unhoused construction so common in the petroleum and petroleum chemical field. Actually, with adequate weatherproofing of the insulation, there is little about a contact plant that needs inclosure other than the blowers, burner firing station and centralized control room. The trend is evident in one of the accompanying views showing a Chemico reconversion unit for alkylation spent acid. Somewhere in the neighborhood of 7 percent of total plant cost can be saved through this reduction in building expense.

What to do with spent acid from nitration and certain petroleum refining operations was a problem that required immediate attention and solution in the early development of the munitions program. That the problem was largely solved is attested by the remarkable results attained. For one thing, nitrations themselves were much improved in respect to acid efficiency. Better centrifugals for nitrocotton meant decreased loss of mixed acid and better recovery. Availability of ample supplies of all necessary strengths of oleum led to an easier approach to acid equilibrium and hence to a smaller discard of spent acid in the refortifying operations. Concentrators themselves were improved, resulting in smaller stack losses. In some cases spent acid recovered from the concentrators was used as absorption acid in oleum towers, further decreasing the need for shipment of spent acid to final consuming points at ammonium sulphate and fertilizer plants. Still another factor tending to ease the situation was the considerable employment of high explosives such as RDX that required no sulphuric acid in their manufacture.

Older methods such as the Chemico hot coke process for the recovery of petroleum-industry acid sludges continued in use on an amplified scale but in addition a new process was installed near three refineries to permit "reconversion" to new acid of the spend acid from alkylation units. Unless such acid is re-used at the refinery for normal lube oil treatment, as it is in a number of cases, alkylation spent acid is too low in organic matter to be regarded as a sludge, but still is somewhat too weak for alkylation re-use.

The reconversion process developed by Chemical Construction Corp. is decidedly simple and flexible, permitting new acid to be made simultaneously from both sulphur and spent acid. Employing a special type of sulphur burner equipped with a Carborundum tube recuperator for preheating the combustion air, the remainder of the plant is largely a standard vanadium contact type. Sulphur is burned as usual. At the same time spent acid is injected through a rotary atomizing nozzle into the combustion chamber where the organic matter is consumed and the acid reduced to SO_2. If the balance between sulphur and spent acid is such as to demand additional heat, fuel gas is burned simultaneously in the same space. The combustion gases are cooled in the recuperator, dried, cleaned and passed on to the converters and absorbers in the normal fashion.

Direct use of alkylation spent acid in the manufacture of superphosphate was another means adopted for the disposal of this material. Built by the Dorr Co. to use a modification of the Dorr strong phosphoric acid process, plus a continuous den, a plant was erected for Southern Acid at Houston to produce both standard and triple superphosphate. With the V-J reduction in aviation alkylate requirements, the plant was operated on spent acid only long enough to demonstrate its success, after which it was necessary to switch to new acid.

Chemico plant for regeneration of spent acid from alkylation process at Consolidated Chemical Industries, Inc., Houston, Tex.

Nitric-Acid—Nitric acid production, of course, was enormously increased for military demands, although most of the increase was at the 24 government plants and is not reported in official statistics. Practically all was made by pressure oxidation of ammonia through conventional methods. Much of the increase is expected to remain in the postwar as the source of fertilizer ammonium nitrate which, through wartime improvements in crystallization and coating methods, has developed into an effective concentrated nitrate for plant food.

Hydrochloric Acid—Much new HCl capacity has been required in the last few years, partly for stepped up conventional needs but also to a considerable extent to supply a source of chlorine in certain chlorinations, some of which formerly used chlorine as such. Anhydrous HCl became an important reagent in organic syntheses, for example, in vinyl compounds and alkyl chlorides; and also important as a catalyst in the Shell catalytic isomerization process for production of isobutane from n-butane. Owing to the extreme tightness of chlorine and the difficulty of its availability for HCl synthesis, most of the new construction involved the use of sulphuric acid and salt, reacting in a Laury type rotating furnace. There was further development in high capacity absorption systems using tantalum heat transfer surfaces; and for the production of anhydrous acid many processes were proposed, including one offered commercially by the Grasselli Chemical Department of DuPont which makes use of chlorosulphonic acid to produce 99 percent pure HCl, together with a yield of 2 lb. of 66 deg. Bé. sulphuric acid for each pound of HCl.

Hydrofluoric Acid—Owing to a number of spectacular uses, not the least of which was production of one form of the atomic bomb, output of fluorides is estimated to have expanded more than five times since 1939. Cryolite for aluminum, Freon production, and the HF alkylation for aviation fuel accounted for the bulk of the remainder although, as was pointed out by Callaham (*Chem. & Met.*, March 1945, p. 94-99) numerous compounds of fluorine have taken on enhanced importance and the production of both the aqueous and the anhydrous grades of HF has become big business. The anhydrous acid, new in the early 1930's, now amounts to perhaps half the HF generated. It is produced by distillation of the 80 percent acid to yield an anhydrous overhead and a 40 percent

bottoms. Potentially useful as a catalyst for many condensations and other organic reactions, this chemical may confidently be expected to assume an increasingly prominent rôle in the future.—T.R.O.

ALKALIS AND CHLORINE

LARGE increases in both capacity and production, coupled with a number of technical improvements, characterized the wartime record of the alkali industries, especially of electrolytic caustic and chlorine. It must, however, be admitted that demand was so difficult to meet that it was necessary to emphasize quantity at the expense of quality and to overlook some of the requirements of peacetime specifications. This was particularly true in the case of soda ash, since the priorities available to the industry were not sufficiently high to permit of necessary expansion, and it was possible to meet production schedules only by pushing plants to the utmost. Improvements to individual pieces of equipment were made, which helped out with the situation, but in only one instance was a plant permitted to expand materially to meet a critical situation in the supply of ash for aluminum.

Estimates for output already given in our January, 1946, issue showed that wartime demand for soda ash, caustic soda and chlorine topped those of the prewar period by large margins and ran well above the projected trend in each case. However, it was pointed out there that these increases were not inordinately large in relation to expected demand within the next few years. As noted above, soda ash production (which expanded nearly 50 percent between 1940 and 1944, the peak year) did not come from any sizable plant increase. Caustic soda expansion, more than 70 percent from 1940 to 1944, came principally from the addition of new electrolytic plants, both private and government financed, including some eleven of the former and eight of the latter.

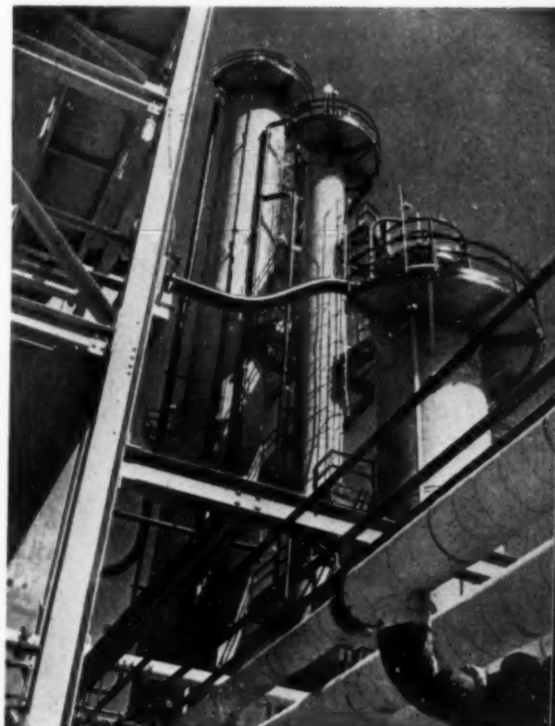
Most of the improvements in equipment and production methods introduced during the war years or immediately before were in caustic and chlorine plants. The greater part of the added facilities made use of the improved Hooker Type S cell, a large diaphragm cell of about 7,500 amp. capacity; in spite of increasing interest in the mercury cell, there was little added capacity of that type.

It is evident that there is a trend toward the use of cells of larger capacity, such as the 7,500 amp. Hooker cell just mentioned. Information now coming out of Germany, showing the great preponderance of mercury cells installed in that country, indicates that the Germans, at least, have found it more economical to use cell capacities of two or three times those of the Hooker cell. The average German mercury cell operates on about 15,000 amp., although 22,000 amp. cells were employed at Leverkusen, and 24,000 amp. rotating electrode cells of a new type, at Ludswigshafen and several other plants. It is argued in the United States that cells of large capacity can be justified only in large plants and that the mercury cell, despite its ability to produce rayon-grade caustic without subsequent purification, suffers from disadvantages in respect to investment and the cost of pre-purification equipment that make its case not entirely clear.

In common with other heavy chemicals, electrolytic alkali production is highly competitive and unit costs must be figured in mills. Tremendous interest in what the Germans have been doing suggests that one of the most interesting postwar interprocess competitions will be the one to determine the proper place of the mercury cell in our own economy.

Other developments in the electrolytic alkali field have been made in conjunction with power supply, with purification processes for brine and cell liquor, and with handling and shipping methods for both caustic and chlorine. Developed shortly before the war, the ignitron type of unit-electrode mercury-arc rectifier made rapid strides and was the principal type power supply equipment installed in the wartime plants. Cells themselves were improved by the use of treated graphite electrodes of longer life. Most plants included facilities for the continuous settlement of treated brine for cell feed. A number of advances came about in cell liquor treatment of which one of the most significant was the patented ammonia purification process developed by Columbia Chemical Division of Pittsburgh Plate Glass Co. This process reduces sodium chlorate content to zero, and chlorides to less than 0.2 percent, producing the much desired rayon grade. This is a liquid-liquid extraction process employing countercurrent contact between 70-90 percent ammonia and 50-70 percent caustic soda solutions. Ammonia is recovered from the extracted impurities by distillation, while the purified caustic is separated from the small amount of ammonia it carries by air blowing or by evaporation of a small part of the contained water.

Several advances in shipping methods occurred, for example, the development of a special insulated car by Columbia Chemical. The container is of welded steel, lined with a modified ethyl cellulose, to permit the shipment of high-purity caustic at 73 percent concentration, rather than the traditional 50 percent concentration. Through heavy insulation the temperature of the caustic can be kept high enough to insure its arrival at its destination still in liquid condition.

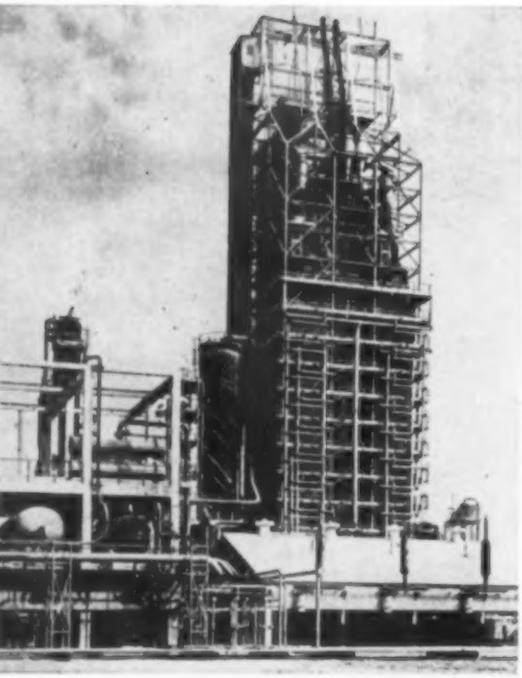


In this sulphuric acid alkylation unit, isopentane and isobutane become aviation alkylate

For chlorine shipment, 55-ton single-unit cars are now in use, employing fusion welded construction, rather than the hammer weld 30-ton single-unit cars that were formerly the largest available. For water delivery to South Charleston from its Natrium plant, a distance of over 200 miles, the Columbia Chemical Division devised a novel scheme of using a barge carrying 380 tons of liquefied chlorine contained in four enormous fusion welded steel cylinders built to withstand an internal pressure of 300 lb.

As before the war, Solvay Process Co.'s nitrosyl chloride process for making chlorine and sodium nitrate from nitric acid and salt was operated actively at a rate reported to have reached 40 tons of chlorine per day for each of its two units. Just before the war started, the process had been subjected to a thorough engineering checkup and revision, putting it on a sound basis that is expected to make it a strong contender in the future, especially in view of the growing agriculture demand for sodium nitrate.

Through efforts of Mathieson Alkali Works, chlorine dioxide emerged as an interesting and powerful new oxidizing and bleaching agent, said to have 2½ times the oxidizing power of chlorine. It is made at the point of use by feeding chlorine and a large excess of air into a tower containing



Two commercial Thermofor catalytic cracking units at the Magnolia Petroleum Co., Beaumont, Tex.

flaked commercial sodium chlorite which can be renewed as exhausted. The air serves to sweep the product stream out of the apparatus and to the point of use.—T.R.O.

PETROLEUM PROSPECTS

MANY notable advances were made in petroleum refining processes during the war years, yet the basic research and engineering on most of these were done during the years 1935-1940, a period characterized by unusual research activity and progress in petroleum technology. The demands of war emergencies channelized the energy and creativeness of the industry; consequently some processes were further developed and commercialized that ordinarily might never have matured, while work on a number of sound peacetime techniques had to be postponed. What were the major processes industrialized during the war years and what are their potential usefulness in our normal, peacetime petroleum industry?

Broadly, the major advances made in petroleum and petroleum byproduct processing during the past five years were in the fields of catalytic cracking, alkylation, butadiene manufacture, toluol production, superfractionation, organic chemical synthesis and special lubricants.

Catalytic Cracking—The outstanding advance made in cracking, and one of the most important in the entire petroleum field, was the development of the fluid and Thermofor catalytic processes and the further industrialization of the Houdry catalytic process. New refinements in all three processes are constantly being made to simplify equipment and operations, improve quality and yields, and to effect product economies.

Generally speaking, catalytic cracking has the advantage over the older thermal methods in that the yields of naphtha, butylenes, isobutane, isopentane and pentylenes are higher; furthermore, the naphtha has a higher octane rating. Its disadvantage has been that it required, in general, a larger operating unit and more expensive equipment and that its technique was more complex. Recently, small and simplified units have largely overcome these objections. Now there is no doubt but that catalytic cracking processes are here to stay and that catalytically cracked stocks will form the backbone of our automobile gasolines for many years just as during the war they became the large-tonnage base stock of our high-octane aviation fuels. In fact, cracked gasoline from these catalytic crackers has a higher octane rating than our prewar premium gasolines.

Catalytic cracking will probably continue to be an important source of raw materials for butadiene and other organic chemicals. From the chemical engineering viewpoint, catalytic cracking may become most important as a pioneering force that has supplied techniques in applied catalysis that will benefit the entire field of process engineering.

Alkylation—Hydrofluoric acid alkylation of paraffins with olefins to produce high-octane isoparaffins was largely a wartime development to supply an alkylate blending agent to step up the octane rating of aviation base stock. Sulphuric-acid alkylation, although developed prior to the war, has been largely industrialized since 1940. The relative merits and economies of the two rival processes are largely determined by the location and size of the refinery, its stock feed, proximity to sources of treating acid and facilities for utilizing spent sulphuric acid.

Some of the 75 alkylation units built, largely during the war, will continue to supply alkylate for commercial military aviation fuels. Others will switch to limited production of blending agents for premium motor fuels, while a large number will probably permanently cease operations as alkylate producers. This field is still in a state of uncertainty as the relative economics of individual units and processes are being scrutinized. In general, the same statement can be applied to isomerization processes.

A major chemical engineering achievement of the petroleum industry during the short period 1942-1945 was the development of methods to produce and purify butadiene for synthetic rubber. Alcohol, at one time serving as raw material for more than 50 percent of our butadiene production, cannot compete in price with petroleum gases. The alcohol units have now been closed down; petroleum will without doubt continue to be the chief source of butadiene for many years.

Of the three petroleum processes in use, that of catalytic butylene dehydrogenation is tonnage-wise the most important, the cheapest and the most likely to survive. Future of the butane dehydrogenation process used by three units may, if natural rubber again becomes competitive with the synthetic product within the next five years, hinge largely upon the demand and price for butylenes for synthesis of organic chemical intermediates.

During the war, toluol from petroleum sources became a far larger source of this chemical for TNT and aviation fuel than the byproduct coke industry. This petroleum toluol was supplied by two processes—hydroforming or catalytic dehydrogenation of methylcyclohexane and extractive distillation. However, since coal-tar toluol is largely produced on a byproduct basis, it is unlikely that petroleum-base toluol will continue to be made unless the solvent and chemical uses for this aromatic should outstrip the capacity of the coal-tar plants to produce it. It is more likely that hydroforming capacity, at least in some instances where catalytic cracking capacity is not large enough to become competitive, will be used to up-grade naphtha for motor gasoline manufacture.

Organic Chemicals — Superfractionation techniques were developed and used on a large scale in the separation of isobutane for alkylation feed or isopentane for use as a blending agent, and in the separation of certain high isoparaffins from high naphthas. Most of these products found their way into aviation fuels. The process required columns of 50 plates or more and reflux ratios of 10:1 or higher. Justification of the added processing cost of fractionating gasoline constituents into narrow cuts will depend largely on the demand and price of aviation fuel. It is likely that war-developed superfractionation techniques will prove of most value as a source of pure paraffinic and isoparaffinic hydrocarbons for organic syntheses.

Although wartime developments in the line of petro-chemicals have been outstanding, this should have been expected from the activity in the field that was developing into a trend even before 1940. The direction of the chemical industry is toward synthetic organics; the direction of organics is toward the use of petroleum and natural gas as raw materials.

In addition to the mass production of butadiene, toluol and isobutane, the petro-

leum industry has turned out large quantities of styrene, alcohol, cumene, acetone, methanol and formaldehyde, vinyl chemicals, glycol, acrylates and other organics for war and essential purposes. Moreover, largely during the war period, the petroleum industry has become a major source of supply for various waxes, naphthenates, synthetic wetting agents and detergents, cresylic acids and now, to a lesser degree, of phthalic anhydride. All in all, the war has served to hasten the maturity of the petro-chemical industry; as a result, the petroleum field is now swinging perceptibly toward chemicals and the chemical field toward petroleum raw materials for tonnage organics.

In the domain of lubricants, the wartime advances made by the petroleum industry are outstanding and of permanent value even if they have received less public recognition than certain other accomplishments. Heavy-duty oils developed for tanks and other military equipment are being adapted through processing and formulation changes into superior products for civilian vehicles of all sorts. Low-temperature greases will find application in refrigeration and other cold-room equipment. New rust preventives have an assured market in peacetime industry; war-developed superior cutting oils will soon become standard in the machine tool and metal working fields. —J.R.C.

PLASTIC PROGRESS

Outstanding gains in volume and diversification of plastic products were made in the last five years. Although prices of many types of plastic materials declined during the period, total volume of the industry in the United States increased 300 percent, from 300 million pounds to a production rate of 900 million per year on V-J Day. Not only did this mean a tremendous growth in that industry, but it indicated a large increase in the demand for the chemical raw materials such as phenol, formaldehyde, urea, acetylene, ethylene, allyl alcohol and chlorine.

One development of note has to do with fluorine derivatives. Several companies have been at work on the substitution of fluorine for chlorine in an effort to improve their present resins. Fluorine derivatives offer greater stability under heat, an achievement that the plastic producer always hopes to attain. If this development becomes successful it would create a market for a portion of the greatly increased output of fluorine.

An aim of the plastics industry has long been to perfect a high softening point thermoplastic. Several such materials have been introduced. One is a polydichlorstyrene which has a heat distortion point of 240 to 265 deg. F. compared to 165 to 190 deg. for the standard polystyrene of commerce. This resin means a new market for styrene and chlorine. Another resin, cerex, combines high resistance to heat with resistance to strong, corrosive chemicals. One of the advantages of nylon as a molding composition is the fact that it will withstand higher temperatures than many other thermoplastics, being servicable at temperatures up to 275 deg. F.

A few years ago a leading producer of resorcin became interested in evaluating it as a resin forming material with the object of stimulating a new market for the chemical. This led to the development of a low-temperature thermosetting resorcin-formaldehyde material that is now well established in the industry. Not only did this development create an outlet for resorcin, but also for caustic soda, hydrochloric acid and other chemicals from which this material is made.

The application of synthetic resins to the adhesives industry has brought about revolutionary changes. Various of the resins are being used to obtain certain characteristics. After several years of endeavor to develop a satisfactory metal to metal adhesive, two types have been found to be satisfactory. One type is a phenolic resin combined with a synthetic rubber. In the other case a precoat of polyvinyl butyral or chlorinated rubber is applied to the metal surfaces and then the two pieces are put together with a cold set resorcin-formaldehyde resin. This development opens an entirely new field to the synthetic resins.

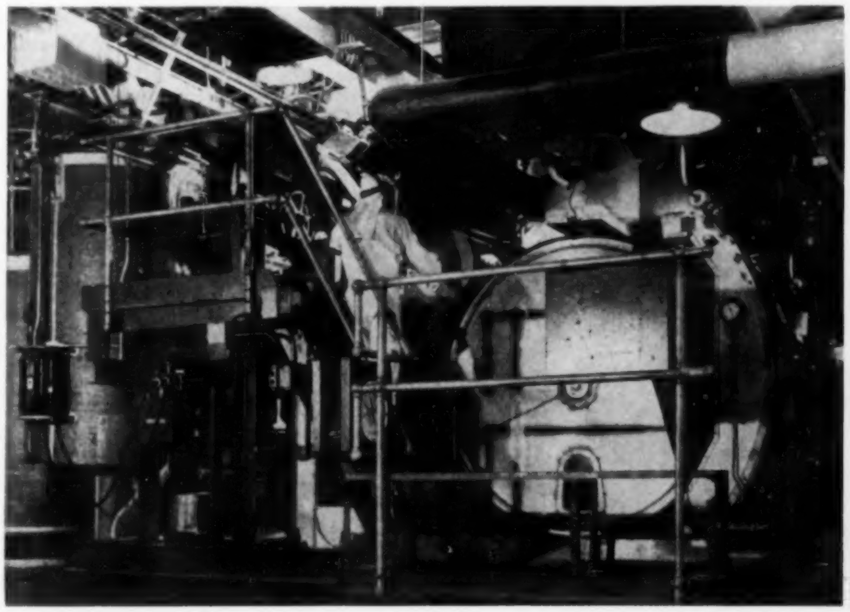
Plywood adhesives are being used in conjunction with a wood derivative known as WT472. This product has reduced the cost of the finished glue line without reducing the cost of, the base phenol-formaldehyde resins and yet makes better plywood.

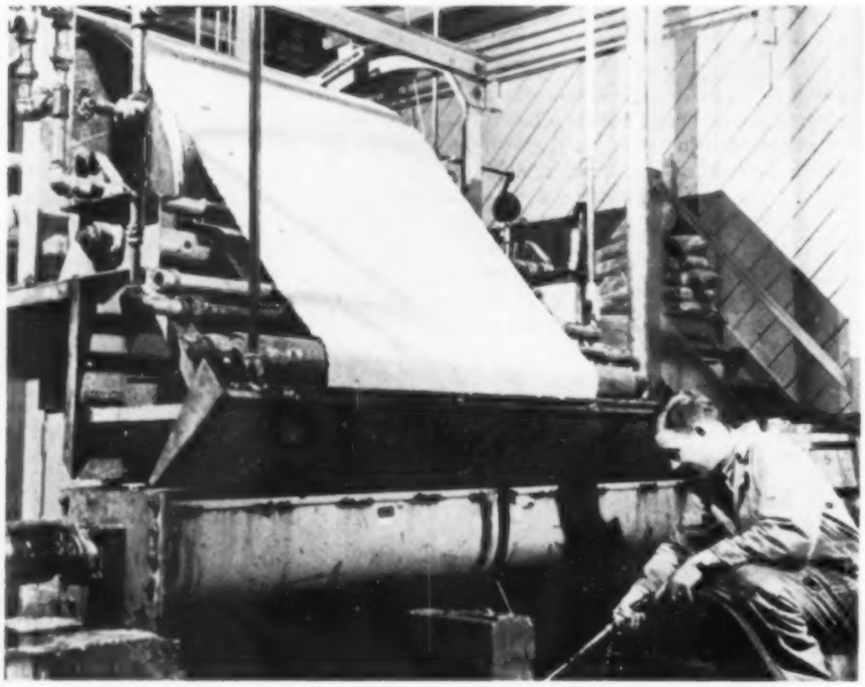
Polyethylene resins give the plastics industry a new type product, a wax-like material which melts at high temperatures and is flexible. Low-pressure laminates or additional polymers, polymerize by addition with no elimination of water. One of these resins is an allyl ester of maleic acid, and another is the allyl ester of styrene-maleic polymerization product. Nylon holding materials are strong and tough plastics about which much more will be heard in the immediate future. Melamines, cellulose propionate and numerous other resins of promise were developed during the war years.

During the war means have been found to acetylate wood cellulose satisfactorily, which will tend to stabilize the raw material situation. Increased use of cellulose acetate and other esters in the rayon field has increased production capacity which will ultimately result in lower cost and higher quality materials for the plastic industry of the United States.

The recent reports on the German plastics industry show that while there were many such developments such as the polyurethanes, polyolefins, polyethylene and polystyrene, that the German plastics industry as a whole had not made as much progress as had the industry in America.—J.A.L.

View of the portable casting wheel where nylon polymer first appears in the Du Pont plants at Seaford, Del., and Martinsville, Va. The molten mass, extruded in ribbon form on top of the wheel, is solidified by the aid of a water bath. It passes over the small drum by the operator's hand, then feeds into a chopper and finally into a portable blender at the extreme left





Engineered mass production of penicillin has been an outstanding advance in applied science in the war years. Here the mold residue is filtered from the dilute penicillin solution at Cutter Laboratories, Berkeley, Calif.

PHARMACEUTICALS AND INSECTICIDES

THE RENAISSANCE of chemotherapy, begun just before the war with the advent of the sulfa drugs, was greatly stimulated by war necessity. It is a curious fact, indeed, that the life-saving sciences and the life-destroying sciences both often have their periods of greatest developments during wars. The reasons are obvious. Wartime advances in the life-saving sciences, to a large extent hinging upon chemotherapy, will continue during peace and the greater merging of chemistry and medicine, aided by engineering techniques, can certainly create a happier era for mankind. The field of preventive medicine, already merging with that of insecticides and fungicides, is particularly promising.

Penicillin is one of the most significant advances ever made in the pharmaceutical field, not only for its own intrinsic value but for the stimulation it has given the entire field. Improvements are still being made in production methods that increase yields, lower costs and improve potency and stability; these can be expected to continue. New methods of administration are also appearing and the field of penicillin applications, both human and veterinarian, is constantly expanding. The large-scale production of penicillin in this country is now, of course, a familiar story in the annals of outstanding chemical engineering achievements.

Streptomycin, produced by a fermentation reaction somewhat similar to that for penicillin, will soon be manufactured on a large scale by several firms. This drug destroys certain gram-negative disease bacteria not affected by penicillin. Several other related antibiotic agents are under research development and may be commercialized fairly soon. These materials represent an entirely new field for our biochemical or fermentation industry.

Progress made in anti-malarials, specifically atabrine, has been outstanding because of the number of lives saved by this chemical during the war and because this drug represents the first major triumph of synthetic chemotherapy over nature's monopoly of quinine. The synthesis of atabrine is one of the most complex in the field of fine chemicals.

The war period also witnessed, and to a large extent stimulated, the remarkable growth of the sulfa drugs and synthetic vitamins. The sulfa drugs are meeting increased competition from penicillin, but the vitamin boom is still going strong. These families of pharmaceuticals illustrate two basic characteristics of the synthetic organic medicinal field: Constant emphasis on increasing output and decreasing costs, and the tendency to tailor-make products for narrow, specific purposes. The first characteristic greatly widens the field of usage, while the second guarantees a steady stream of new and improved products.

Developed entirely during the war, the present commercial process of blood plasma fractionation has already chalked up credit for saving many lives. These blood plasma proteins are now finding many uses in medicine. The field is still pioneering, so that further advances will undoubtedly be made in the technique of blood fractionation.

The dramatic appearance of DDT in the insecticide field accelerated and drew attention to the trend of this industry toward synthetic organic chemicals which had been taking place since about 1937. DDT itself can go down in history for any one of three reasons: (1) For its contributions in the field of preventive medicine, both during the war and in the coming years; (2) its value as an agricultural insecticide; (3) the stimulus it has given the insecticide industry to develop other organic chemicals of specific insecticidal properties. Manufacturing improvements and better formulations will certainly put DDT on a competitive basis in respect to the prices of a large number of the old-guard inorganic materials.

A promising new insecticide known as Gammexane, 666 or benzene hexachloride, has been reported already in production in England. The new hormone weed killer 2,4-D or 2,4-dichlorophenoxyacetic acid, is one of the most promising agents of its kind yet found. Already in large-scale production, its usage is growing rapidly. DD Mixture, actually a mixture of 1,3-dichloropropylene and 1,2-dichloropropane, offers promise of becoming one of the cheapest and most effective soil fumigants. The principle of aerosol dispersion of insecticidal agents, developed for military use in the tropics, is finding increasing applications.

The necessity of protecting military personnel in the tropics from mosquitoes led to the development of dimethyl phthalate as an insectifuge. Later dibutyl phthalate and benzyl benzoate were developed for the same purpose. These materials will probably continue in use as insect repellants, although perhaps not on such a large scale as during the war. One of the latest developments in the industry, also indicating the trend of the field toward synthetic organics, is the remarkable rodenticide sodium fluoracetate, known as 1080. Extremely effective, this chemical is so dangerous that its use will be closely restricted. It will probably largely replace the thallium rodenticides.

And probably the most significant development of all is that many of these industries that formerly operated small-scale batch processes have now become large, efficient chemical engineering operations. Thus the chemical engineer has added another important sector to his ever growing field of service to humanity.—J.R.C.

PULP AND PAPER PROSPECTS

A REVIEW of the pulp and paper industry over the past five years reveals few new processes but a number of new and improved products, especially in the packaging field. Processes remained about the same during the war except for certain modfiications and improvements. For the most part, only direct labor and material saving equipment was installed, but now that war restrictions are off, new processes are being adopted, some of which should find wide use in the future.

During the war, paper found itself the universal substitute, beyond which there were no others. While it uses have been innumerable, one of the most pressing needs was for improved packages which could stand up to the rigors of overseas shipments for war. This led to an integrated research program resulting in the production of V-boxes and other similar packaging improvements. Even in 1942, over 325 distinctly different types of commodities were packaged in paper, stored and shipped to all parts of the world; and this number increased as our war efforts widened. Although production of such war materials has been cut back, the whole field of packaging will be affected by the stimulus of war improvements. Not only does this mean better packages for industry but a continuing market for all sorts of chemicals used in these products. New and improved resins, adhesives, waxes, plasticizers, sizing agents, and other chemicals have become indispensable and will help paper meet the renewed competition of wood, metals, and glass. While packaging requirements will not now be nearly as rigorous, the experience of war should help this industry maintain its position in peace.

Machine Coating—One of the most important trends in paper making at present is in the manufacture of machine coated papers. Formerly, the coating process was completely separated from paper making. Now coated paper may be made on the paper machine itself. The sheet is formed and dried before passing directly through the coating process, then over a second section of dryers to be wound on the reel as finished coated stock. By this technique, higher quality coated papers are possible.

Pulpwood Production—A number of developments took place in the manufacture of pulp which may well be classed as basic changes. These range from new methods of producing pulpwood to new processes for cooking and bleaching pulps. Probably the most neglected part of the industry, pulpwood production methods have lagged far behind. Motivated by the nationwide labor shortage, which stripped the woods of men, mechanical power equipment took over many traditionally manual jobs. Most of this equipment was available before the war and only needed the impetus of war conditions to foster its widespread use. Power driven saws became a "must" for efficient woods operations. Greater use of tractors and lightweight logging equipment helped get the logs out of the woods. Portable pulpwood mills were also developed, some of which show considerable promise in lowering production costs.

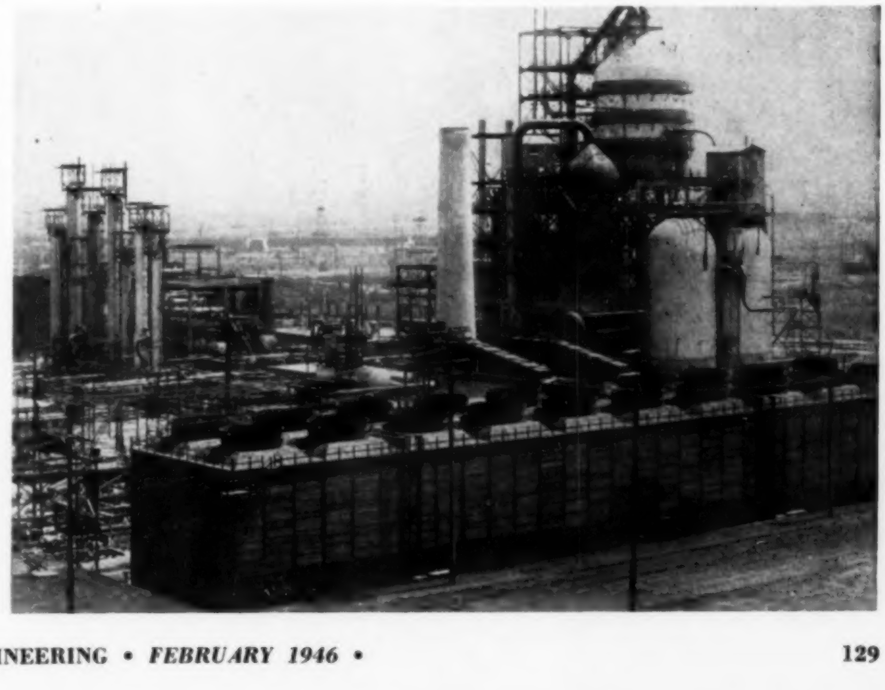
One project which has come to fruition in recent years is the hydraulic barker. Several West Coast mills participated in this development which, beginning in 1933, resulted in a log peeling device now responsible for a tremendous reduction of wood waste. In one mill, waste has been reduced by one-third with appreciable labor savings. Based on the use of high-velocity water jets for stripping the wood of its bark, some of these machines require water pressures of from 650 to 1,400 lb. per sq. in. Different types of log-handling equipment are used, some of which can accommodate logs up to 32 ft. long and 72 in. diameter. While most of the units used in West Coast mills were engineered and built by the users, hydraulic barkers are now commercially available in standard models.

Another device, based on well known principles, is the hammer barker, which through the use of rapidly moving hammers knocks the bark from pulpwood sticks. It, too, is claimed to have excellent possibilities.

Pulping Processes—Two new pulping processes have been developed which seem to hold much promise for the future. The magnesium base sulphite process has undergone pilot plant tests and is now being installed for full scale plant operation. Here magnesium replaces calcium as the base for the sulphite cooking liquor wherein the waste black liquor is evaporated and burned in a manner similar to the sulphate (kraft) recovery process. The ash from the smelter consists mainly of magnesium oxide, which is made into a slurry for absorbing sulphur dioxide to form the fresh cooking liquor. High operating efficiencies are claimed for this process which utilizes the energy value of the organic waste and recovers a large portion of the active chemicals in the cooking liquor. The availablity of ample supplies of high purity magnesium oxide seems assured due to the wartime expansion of magnesium producing facilities. One of the most important features of this process is that it eliminates the problem of waste liquor disposal.

Another process recently put into operation is also a modified sulphite system in which the calcium base is replaced by ammonia. In this case the waste black liquor is evaporated and burned to leave no ash. A direct heat-transfer evaporating system is used wherein the hot combustion gases evaporate the moisture from the liquor prior to its being burned. While no recovery of heat or chemicals is accomplished in this process, elimination of the waste liquor problem is a major objective. Both the magnesium and ammonia base sulphite systems achieve this end, which is so important

The Texas Co.'s Los Angeles Works uses this fluid catalytic cracking unit. The fractionating section is shown in the background. The 30,000 g.p.m. induced draft cooling tower is in the foreground



Here pigment is ground in soybean oil to explore new industrial uses for the soybean

in preventing stream and water pollution.

Semichemical pulps are showing greater promise than ever before. High yields are obtained by giving the wood a partial cook followed by disintegration. Pulps thus obtained have quick hydrating properties. Semichemical pulps for certain purposes are now being successfully produced by a continuous process. This branch of the industry has attracted considerable interest and should become more important in the future.

During the war, supplies of saltcake used in the sulphate process were so inadequate that a number of mills turned to a synthetic saltcake consisting of sulphur and soda ash sintered together in the correct proportions. The increasing availability of natural and byproduct saltcake will affect the future of the substitute cake, but a number of mills have had such favorable results with the sintered material that its use should continue in some quarters, depending, of course, on the over-all economy.

Groundwood Bleaching—Long a subject of interest, commercial bleaching of groundwood became a reality early in the war. Based on sodium peroxide, the process consists of mixing bleaching liquor with slush pulp in controlled proportions, allowing the mixture to stand long enough for bleaching action to take place, and then neutralizing any excess peroxide. Groundwood pulp bleached by this process retains its desirable characteristics for producing papers of good bulk, high opacity, and good printing qualities, and to these are added improved color, brightness, and better permanence. This new process is expected to widen the usefulness of groundwood pulp.—R.W.P.

FATS, OILS AND SOAP

Wartime fats and oils technology made significant advances in several fields. Progress in the soap field included considerable increase in capacity of the synthetic organic detergents. This was partly due to demand for soaps which could be used by Army and Navy when only sea water or very hard water were available. Capacity of the soap industry for production of these synthetic detergents is said to be approaching 10 percent of the volume of ordinary soap, representing an advance to three or four times the early war-year capacity.

In the drying oil field, paint manufacturers were forced by shortage of preferred raw materials to adapt the semi-drying oils to uses far more rigorous than normal peacetime standards. Although results were not always as favorable as might have been desired, we were able to get along pretty well. Some of the new techniques which were developed may even continue into the postwar when prewar raw materials are again available.

Edible oil technology continues to be faced with the perennial keeping-quality problem. Products of longer life have been developed and the Quartermaster Corps contributed materially in this direction through the Food Research Committee. Deterioration is still a problem, however, and improved quality in food products containing fat is still being sought.

Among the most recent advances in fats and oils technology, occurring within the past year or so, should be mentioned the improved soybean and linseed oils which result from catalytic conjugation without decomposition. The best catalyst found thus far is nickel oxide on carbon black. These conjugated oils can be bodied to the same viscosity as can the alkali-refined oils but without the substantial loss of oil and increase in acid value that occurs with the latter. The bodying can be achieved in much less time than from the corresponding alkali-refined oil.

Paints made with the conjugated soybean oil "set" to the touch two or three times as fast as those made with alkali-refined soybean oil. It is also believed to be more suitable for use in primer coats because it does not penetrate porous surfaces as rapidly or to such a large extent. Other specialized industrial uses of these conjugated oils are said to be in the development stage.

Mild selective hydrogenation of tallow prior to saponification has been found to eliminate troublesome variability in tallows from the standpoint of their use in making tallow soaps for polymerization and emulsifying agents used by the synthetic rubber industry. This development resulted in a substantial increase in the production capacity of GR-S synthetic rubber plants and greatly assisted in the changeover of the copolymer plants to continuous operation.

In this connection, a spectrophotometric method of analysis was found to be superior to any chemical tests for detecting the presence of residual poly-unsaturated fatty acids in the hydrogenated fats and their soaps. Determination of this hydrogenation technique and the spectrophotometric analysis has permitted the use of non-edible tallows and greases, helping ease the demand for edible tallows formerly required for the synthetic rubber program.

Selective hydrogenation of the separated fatty acids has made possible preparation of refined oleic acid, either by the usual method of cold pressing or preferably by fractional crystallization from solutions. Subsequent fractional distillation can achieve oleic acid having a purity of over 95 percent, with much higher stability of color and odor than commercial red oil.

Basic data on specific heats and heats of fusion have made it possible to estimate for the first time the proportions of solid and liquid in a number of plastic fats at different temperatures within the complete melting range. Systematic studies have also been made of vegetable oil solution densities and viscosities in organic solvents. These data and boiling point-vapor pressure-composition relationships in mixtures of oil and solvents should be helpful in designing equipment and devising processess that involve the handling of such oil-solvent mixtures.

Fractionation of cottonseed fatty acids by solvent crystallization has achieved practical separation of the liquid and solid acids. Re-esterification of the resulting acids, which are now being evaluated, may produce a number of industrially useful products.

Use of soybean meal in a phenol-formaldehyde adhesive for waterproof plywood has also been demonstrated recently on an industrial scale. Since this new adhesive costs less than other waterproof adhesives, it may prove to be an attractive new byproduct outlet for some of the soybean oil producers —G.W.M.

WARTIME FERTILIZERS

Manufacture in the United States during the war period of several vital new fertilizer chemicals will unquestionably continue as a contribution of chemical engineering to peace years. Many of the changes in plants and processes had their greatest

benefit in increasing output of old fertilizer works beyond the prewar rate of production, and with substantial labor saving. Those changes, though not spectacular, will also contribute to postwar economy in the making of mixed fertilizers.

Outstanding improvement in materials production occurred in the field of synthetic ammonia. Plants designed on the assumption of prewar throughput were stepped up bit by bit until they operated regularly and efficiently at as much as 160 to 170 percent of design capacity. This required many seemingly minor changes in chemical engineering technique. But the composite was the gradual widening of one bottleneck after another until the unit capital costs of these plants became barely half of that which would be applied at prewar rates of operation.

The outstanding new ammonia product for independent fertilizer use is coated and dusted ammonium nitrate granules. Collaboration of military, TVA, and private chemical engineering talent achieved a production which can be used successfully in fertilizer distributing equipment despite the high humidity which is regularly experienced in southern agriculture. Thus this chemical has been made a permanent competitor of sodium nitrate and ammonium sulphate which formerly dominated the business of top dressing and side dressing of crops.

Until the interruption of imports of European potash into this country, almost all potassium sulphate used here came from German or French sources. Now American users can look to domestic production for regular supply of this important chemical. The temporary scarcity of the early war years taught agriculture to use less sulphate and more chloride. But no experimentation could have made the chloride satisfactory for certain outstanding crops, such as tobacco. American farmers needing sulphate can now get this product without difficulty, because of the new chemical engineering which the potash industry has firmly established as a result of war necessity.

Not war born but largely war stimulated is the present phosphate rock technology which chemical engineers have put in practice, especially in Florida. The result has been a very great increase in recovery of phosphate and production of abundant high grade rock by a combination of flotation and related chemical engineering practices not common in prewar years. This will greatly extend the life of present proved phosphate reserves; and it makes readily available on an economic basis much low-grade rock that formerly could not command a ready market.

The making of superphosphate itself has not greatly changed during the war years. But the extent to which it is ammoniated has increased greatly. Almost all superphosphate for which ammoniating facilities are available is now so treated. Only thus can the fertilizer maker make maximum use of the available supplies of anhydrous ammonia, which is abundant. Only thus can he get a maximum tonnage of wanted fertilizer with the limited supplies of those other nitrogen carriers, such as ammonium sulphate, which can be mixed with superphosphate in unlimited quantity without causing reversion.

In the aggregate the technologic advances achieved by makers of fertilizer chemicals and mixed fertilizers have given agriculture an adequate, though not overly abundant, supply of plant food. These technical advances have made possible a record American food supply, which must serve not only the United States but also many other hungry areas of the world. All of these advances in technology remain to aid also in economic and efficient supply of fertilizer for postwar years.—R.S.M.

ALCOHOL AND FERMENTATION PRODUCTS

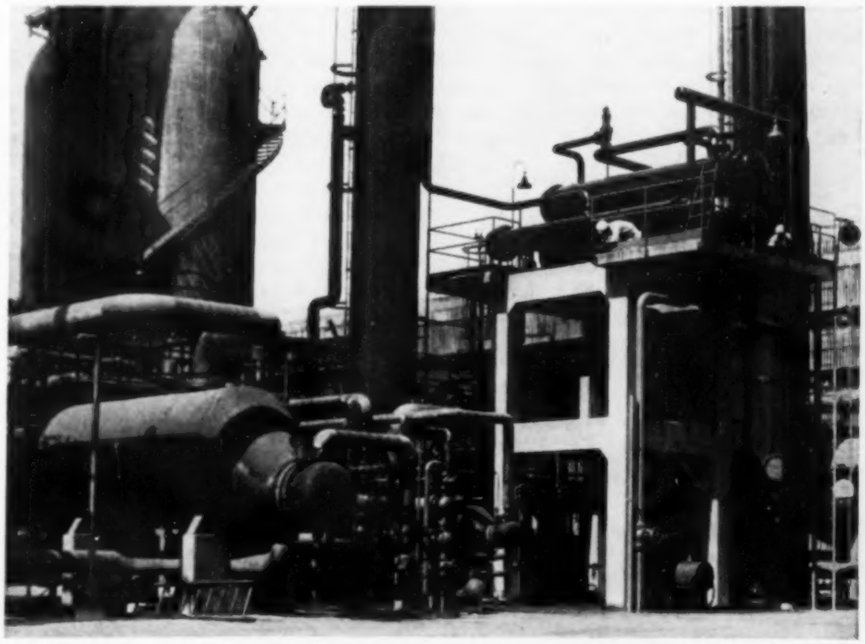
IMPROVED fermentation technology during the war came from two major influences. Highly refined control was necessary for the new processes of manufacture used in making such products as penicillin. For more prosaic products like alcohol, the urge came from the need for maximum possible yield from all sorts of novel raw materials.

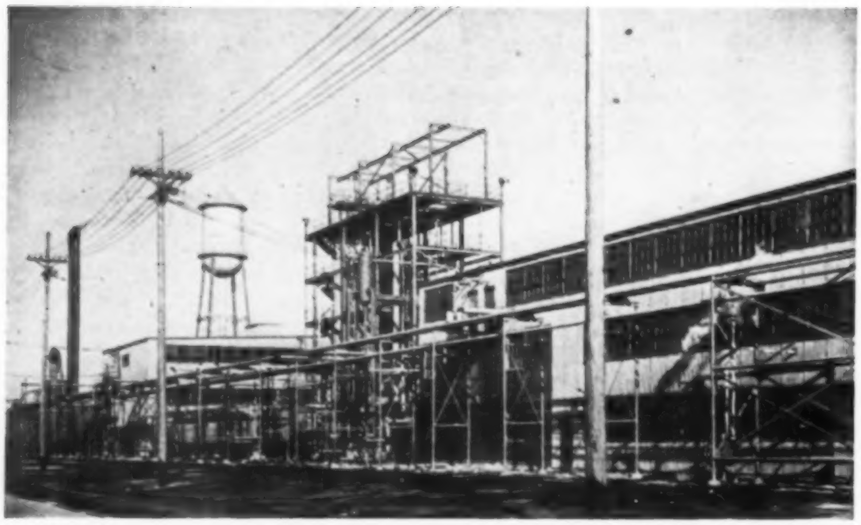
The demand for alcohol in the synthetic rubber industry compelled a changeover from beverages to industrial alcohol at every distillery. These establishments were all in competition with farm animals and food markets for the more important grains especially corn. Thus these establishments were compelled not only to change to a new end product but also forced to devise fast processing methods, using all sorts of unusual grains as raw material.

Outstanding in magnitude was the use of granular wheat flour. The fermentation problem here is not so serious as was the recovery of distillers dried grains. The gluten in the wheat made normal methods of processing on corn-dried grains impractical. In the postwar period all of these adaptations of process and raw material give a new flexibility which may occasionally become of importance if the beverage man again shifts to industrial alcohol when beverage surpluses or industrial scarcity makes this economically desirable.

In a few instances plants have adopted radically new fermentation methods, especially for continuous and automatic processing. These developments have not been fully commercialized. But it is not mere speculation to forecast new alcohol and other fermentation establishments in which minutes and hours will suffice for conversions which took days, or even weeks, with prewar rule-of-thumb procedures. The over-all result may put some fermentation products into a new competitive relation with other solvents and certain synthetic chemicals.

The Wilshire Oil Co. uses this gas concentration equipment for the production of alkylate by the hydrofluoric acid process in the manufacture of 100-octane aviation gasoline in a government-owned plant at Norwalk, Calif.





This Dow Corning Corp. unit at Midland, Mich., is the first plant in the country to be designed exclusively for silicone production. Its products are in the form of fluids, resins, varnishes, greases and silicone rubber.

The production of penicillin has been achieved by one of the largest scale fermentation programs ever laid out in history. Research on raw materials and research on use of the product went hand in hand with plant construction and operation. Countless lives were saved by the availability of this material and the present indication is that fermentation-produced penicillin may continue for some time to be the principal source of this aid in the eternal war against diseases.

In the production of penicillin, deep tank fermentation was employed on a scale hitherto never tried. New strains of yeast were developed as the production program continued, yielding increased quantities of penicillin and achieving greater efficiency of production. Supplemental nutrients were also investigated with considerable success. Team work between industrial and government research laboratories in this program set a new high for friendly and productive collaboration.—R.S.M.—G.W.M.

SILICONES

UNDOUBTEDLY the silicones constitute one of the major developments of this war. Although this unique family of polymers had its beginnings years ago in the researches of England's Dr. F. S. Kipping, it had no practical implications until very recently. The first commercial products were announced in 1944. It is now apparent that silicone chemistry may become as ramified (and as multi-fruited) as certain branches of organic chemistry. In fact the simplest way to picture a silicone is to visualize an organic polymer with silicon-oxygen linkages taking the place of the familiar carbon linkage. The character of the final product depends upon the nature of the linkage—straight chain, cyclic, cross—and the nature of the appended organic radicals.

Silicone polymers fall in general into four classes: Resins, rubbers, greases and fluids. Possible variations within each class are almost infinite, but despite this, there is one characteristic common to all silicones. It is their outstanding property and the one which all applications to date have tried to exploit. No matter what form a silicone takes—temperature has surprisingly little effect on its properties. Motors insulated with silicone varnish can operate at exceptionally high temperatures. Silicone rubbers withstand high temperatures but also remain flexible at −70 deg. F. There is little change in the consistency of greases from −40 to 400 deg. F., and the viscosity of damping and hydraulic fluids shows similar stability. The silicones at times demonstrate other important qualities—chemical inertness and water repellency, for example—but it is their non-sensitivity to temperature that has drawn the most comment and raised the highest hopes.

At present, only the Dow-Corning Corp. is in commercial production, but the General Electric Co. hopes to begin operation in a new plant this year. These two companies, which are the only ones to enter the field so far, employ different processes to arrive at the same end point, Dow-Corning working through the Gringnard reaction and G-E using metallic silicon as a starting point. The industry is obviously still in its infancy but there is little room for doubt that the silicones will go places as soon as production limitations are overcome.—E.C.F.

ION-EXCHANGE

ANY report on industrial progress would be incomplete without considering ion exchange processes. The principles involved in these processess are well known and their importance in water treatment, from the familiar zeolite water softening to the complete demineralization process now possible with various organic materials, has been widely publicized. Perhaps the most spectacular accomplishment during the war was the development of a desalting process for purifying seawater. Consisting of ion exchange together with precipitation, this process utilizes a silver zeolite which reacts with the salt in seawater to form sodium zeolite and silver chloride, both insoluble and filterable. Peacetime applications will probably be limited to emergency use, as they have been in war, to provide potable drinking water for personnel stranded at sea. Obviously, the high cost of the silver compound will eliminate commercial scale use of this process.

Although by far the bulk of all installations using demineralizing processes are for water treating, a number of interesting developments show promise in other fields. A good deal of experimental work has been done on the purification of sugar juice by ion exchange. Actual removal of a substantial portion of the dissolved impurities by two-step demineralizing makes it possible to crystallize a larger proportion of the sugar from the sirup than previously possible since the presence of alkali metal salts tend to inhibit crystallization. High percentage removal of both salts and organic impurities measurably reduces the ash content and improves sirup color. Removal of scale-forming salts practically eliminates evaporator scale, thus lowering maintenance costs.

Another process having good possibilities, utilizes cation exchangers for removing calcium, potassium and magnesium ions in the preparation of high quality pectin from grapefruit peels. This process is expected to compete favorably with other methods now in use.

Anion exchange is now commercially used for the removal of formic acid from formaldehyde. The value of this development lies in the fact that acid-free formaldehyde is necessary in the manufacture of formaldehyde resins. Considerable interest has been shown in the extraction of alkaloids such as quinine. Work has progressed far enough to indicate a successful future in the use of cation exchangers in this field. Extraction of metals from dilute solution has been developed to the point where it shows good possibilities for recovery of precious metals.

Numerous other applications for ion exchange have been studied. Already attracting wide interest for both water treatment and other uses it will undoubtedly increase in value to the process industries.—R.W.P.

GLASS PRODUCTS

Though glass fiber was on the market before the war, the tremendous expansion in its application makes it one of the most talked of features of the glass industry. Its largest use has been as thermal insulation in the form of bats, rolls, blankets, and boards—most of it in merchant marine and navy ships and lesser amounts in aircraft and ground installations. Production of the board alone exceeded 22 million square feet in 1942 and that amount doubled and tripled in the next two years. In other applications, glass cloth was coated with resins and with rubber; lightweight cloth-resin laminates were employed as body armor and as aircraft structural members; and in one form or another, Fiberglas found its way into camouflage, electrical insulation, tower packing, and the air filters of the world's largest air conditioning system (that bomb again). As to manufacturing processes, refinements have been made, but in all basic respects the methods employed today are the same as those developed before the war. However, it has been possible to reduce filament diameter from 0.00020 in. to about 0.00005 in.; the latter was used as a kapok substitute during the war and is being projected now as inner lining for winter clothing.

Advances in the field of optical glass are doubtless just as significant as those for fibers, but far less information has been released. It is known, for example, that the Bureau of Standards has accomplished much in the improvement of formulas and melting practice, but details are not available.

Surface treatments have been perfected which can reduce the amount of reflected light to 0.5 percent, as against 4 percent for the best untreated glass. Several methods have been employed for this purpose but in any case the object is to produce a transparent surface film ¼ wavelength in thickness. The two most prominent processes produce a film of calcium or magnesium fluoride. In one procedure the fluoride is volatilized under vacuum and made to condense directly on the glass surfaces. In the other, alkalis are etched from the surface and, "by chemical treatment," a film of silicon tetrafluoride is formed; this is subsequently volatilized to leave a film of calcium fluoride. Improved techniques have been developed for raising the corrosion resistance of optical glass; these consist essentially of leaching out the surface alkalis and refiring to form a film of almost pure silica.

Electronics has boomed during the war, so it is not surprising to find that the electrical applications of glass have taken correspondingly great strides. Metal-to-glass seals are vastly improved, and extremely thin sheets of glass can now be produced to take the place of mica in capacitors, though the latter development came too late in the war to be much used. In the insulator field, two prewar embryos, Multiform and Vycor, have risen to prominence. The former is a process which permits the fabrication of shapes not readily produced by conventional methods and consists of pulverizing a Pyrex glass and casting, molding, or extruding it under heat and pressure to form such objects as coil forms, bushings, and filament guides. The latter, Vycor, is an ultra-low-expansion, 96-percent silica glass. It is produced by leaching with acid a normal object made of borosilicate glass, to leave a skeleton of almost pure silica; when this is refired it "condenses" and shrinks (predictably) to yield a transparent object of the same shape as the original but about 35 percent smaller and comparable to fused silica in its immunity to thermal shock.

There appears to be an awakening interest in the commercial possibilities of the phosphate glasses, which for many years have been little more than playthings for glass technologists. A type which is resistant to hydrofluoric acid has been put on the market and other types—which offer ultraviolet transparency, low thermal expansion, or low electric current loss—are under serious consideration.

The glass container field has attracted much attention during the war, first for its remarkable growth quantity-wise (50 million gross in 1939 and well over 100 million gross in 1945), and secondly for the development of lightweight, one-way containers. This lightweight program is considered to be a definite trend and is one reason why the production figures for glass containers are not expected to drop back to anything like prewar levels in spite of the return of "tin." The technical advances which make these thin-walled vessels possible have been primarily in the fields of container design and the improved control of composition in batch melting.

Finally, mention should be made of Foamglas, which was made available in 1942 for use as thermal insulation. As its name implies, a block of the material is a mass of tiny bubbles formed by the evolution of gas in the molten glass. Its advantages, as compared with other insulating materials, are rigidity and strength, which are great enough to support its own weight in any type of wall construction.—E.C.F.

PAINTS AND VARNISHES

For the paint and varnish field the war really began in 1937 at the Marco Polo bridge, for this incident quickly developed into the squeeze on raw material oils that set the stage for some of the industry's most important developments within decades. Some of the outstanding processing advances that have occurred or largely matured since the outbreak of the European war include industrialization of processes for fractionation of natural oils and fatty acids; intensified use of alkyd and modified alkyd resins; development of dehydrated castor oil for imported tung oil; catalytic isomerization for producing conjugated fatty acids; development of zinc chromate and improved types of titanium pigments.

Notable progress has been made in solvent fractionation of natural oils to improve drying characteristics by removing unsaturated glycerides or non-polymerized fractions. Linseed and soybean oils, for instance, are now being separated on a large scale into fractions valuable both for use in paints and in food products.

Just getting into their stride in the coatings industry when the war practically froze further development, the alkyd resins are assured of a large and expanding market in this field. The most recent trend is toward the use of modified alkyds for specialized industrial applications. Pentaerythritol and other polyhydric alcohols can be used in place of phthalic anhydride; high polymer resins are also attracting consider-

These glass marbles will be melted and drawn into Fiberglas textile fibers

able attention. Future developments in the paint and varnish field will definitely be closely associated with those in the fields of synthetic resins and high-polymers.

Catalytic isomerization of soybean, linseed, cottonseed and other oils for alkyds or straight varnishes is closely related to the production of conjugated castor oil. The process results in a drying oil by shifting isolated double bonds to the conjugated position, after which the fatty acid can be esterified with various polyhydric alcohols. Considerable advances in equipment and technique are expected in this field within the next few years.

All these developments have been in the domain of drying oils and resins. They serve to emphasize the most significant trend in the protective coatings field—natural oils for use as such in paints and varnishes are giving way to processed and semi-synthetic oils.

In the line of pigments, greatest advances have been made with the phthalocyanine and titanium-base materials. Phthalocyanine blue and green, because of their high tinctorial power and resistance to light, weathering and alkalis, promise to increase rapidly in usage. Zinc chromate has been used extensively as a primer.

Development of a rutile crystal form of titanium dioxide in 1941 proved to be a basic improvement that greatly increased the hiding power of this pigment. A superior non-chalking titanium pigment has been developed by catalytic recrystallization of the oxide from the anatase to the rutile form.

Other wartime developments in paints and varnishes that represent permanent improvements include the alkyd and other resin oil-in-water emulsion paints; use of polyhydric alcohols in place of glycerine for certain specialized alkyd-type resins; soybean oil alkyds for non-yellowing interior paints; improved anti-fouling and other marine paints; cheaper and better luminous and fluorescent compositions; low-solvent varnish formulas and hot-dip materials; insecticidal paints based on DDT as the active ingredient.—J.R.C.

ELECTROCHEMISTRY IN WAR

Although the war years saw the publication of no radical advance in basic electrochemistry, its practical engineering applications made vital contributions to the war effort.

In electroplating, perhaps the best-publicized development was the continuous electrotinning of strip steel. Although this process had its beginnings well before Pearl Harbor, its advance to full-scale production may rightly be classed as a war development. Some of the interesting features were the large scale of these installations, the exacting quality standards which had to be met, and the announcement of several new tin-plating solutions especially adapted to continuous high-speed operation. Induction heating was used extensively in the melting or "reflowing" step, and rectifiers found application as a source of d.c. power.

Continuous plating of full-width strip is adaptable to other metals besides tin, and success was reported in converting one of the "lines" to zinc-plating. Related processes were in use for plating of wire.

Electroplating turned from decorative uses to the job of protecting the countless cogs in America's war machine against the most extreme corrosive conditions. Plating to exacting specifications became of the first importance; the knowledge gained therefrom will have permanent good effects, and testing techniques were vastly improved. Every electroplated metal received its share of study; there is space to note only improved methods for lead, lead-tin alloys, indium and silver in bearing production; tin-copper alloys as nitriding stop-offs, tin-copper-zinc in electronics; "hard" chromium in machine tools and "porous" chromium for cylinder liners and piston rings; composite coatings such as nickel-zinc, heat-treated after plating. Many more new or improved plating processes became available and made their contributions in production speed, quality, or other ways. Plating on plastics found application in radio, aircraft, and related fields. The manufacture of radar parts by electroforming was an important development recently reported.

The greatly expanded use of the light metals, aluminum and magnesium, entailed electrochemical methods such as "anodizing" for their protection. Other non-metallic protective coatings included several of the chromate type, particularly for zinc surfaces, and such dip treatments as "Bonderizing" which supplemented the electrotinning program. "Electropolishing" as a method of metal finishing was added to the tools of the trade.

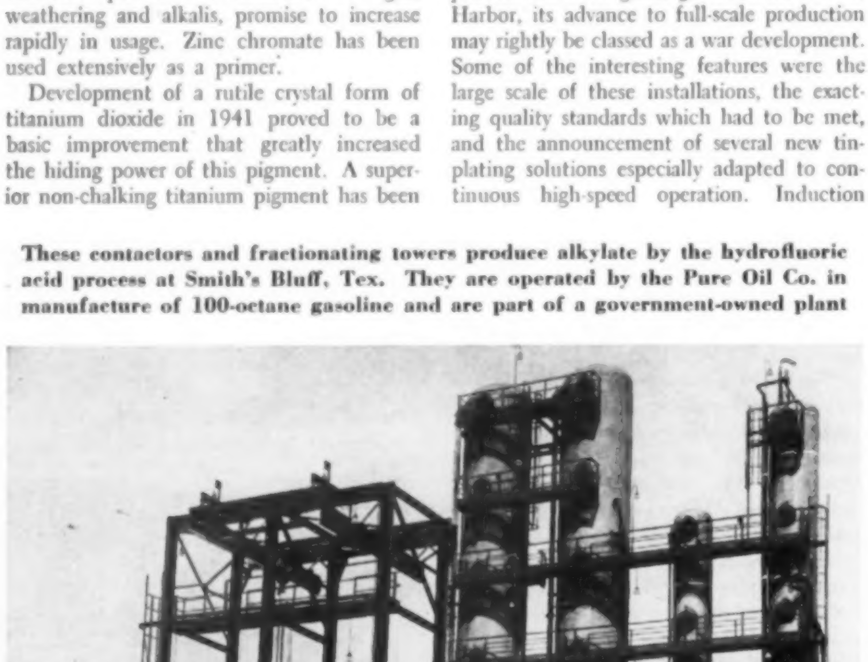
Among electrolytic metals, the production of magnesium expanded many-fold; manganese and calcium must also be mentioned. Successful experiments on cathodic protection of pipelines with magnesium were reported.

Potassium perchlorate, made by the electrolytic oxidation of chloride in a new West Coast plant, was a development of great importance. (See *Chem. & Met.* Dec. 1944, pp 108-9; 130-3.)

The battery industry took rapid strides both in improvement of the product and in successful substitution for materials in short supply, but little in this field has yet been published.

Space has permitted the mention of only a small fraction of the developments in electrochemistry. They represent for the most part the intensive cultivation of old fields rather than the clearing of new. The latter is our job in the years ahead.—J.A.L.-F.A.L.

These contactors and fractionating towers produce alkylate by the hydrofluoric acid process at Smith's Bluff, Tex. They are operated by the Pure Oil Co. in manufacture of 100-octane gasoline and are part of a government-owned plant



NEW UNIT OPERATIONS AND EQUIPMENT

Open New Vistas for Postwar Chemical Engineering

EDITORIAL STAFF

Any attempt to survey the whole range of developments in the unit operations and their equipment during the period since 1940 inevitably must overlook the less significant advances. Furthermore, to make such an attempt critically, with the writer endeavoring to single out the most significant, inevitably lays him open to charges either of unfairness, of lack of discrimination, or of knowledge. Still, presumptuous as it may be, this is what is attempted here. If the reader will be charitable, the writer will gladly assume responsibility for this summation of discussions with many engineers.—T.R.O.

YEARS of wartime are inevitably years of spotty development, even in a field such as chemcial engineering which so thoroughly permeated the production of the munitions and the weapons of war, as well as those other weapons of industry behind the front lines. Hardly a tool of war, or a military activity of any kind, and scarcely a form of industrial endeavor contributing to the military effort, was not related closely to some activity of the chemical and process industries.

Nevertheless, years of war are years of great pressure at certain points, and of little or no pressure at others. It is clear that equal development could hardly have been expected throughout chemical engineering. Some unit operations and some types of equipment are now years ahead of any conceivable position they might have occupied if no war had been fought. Others have lagged behind what might normally have been anticipated. The same is true of engineering progress in general which has been advanced in many directions to an almost unbelievable degree, and yet at other points has been neglected or even hindered.

Some things, glancing back over the past five years, are so prominently displayed against the background of 1940 technology, that they inevitably can be nominated as outstanding. Some of these are obviously chemical engineering—others as obviously are engineering of another sort which may still be significant from some future chemical engineering standpoint. In the first case we have those techniques which in time will be considered as new unit operations, if they are not already so regarded. Included here are separations for molecules based on gas diffusion, thermal liquid diffusion, electromagnetic forces applied to ionized particles, and molecular short-path distillation and condensation. Also here is the new technique of handling solids "fluidized" and suspended in gas or vapor for heat transfer, reaction or catalytic purposes.

In addition to these new unit operations there are a considerable number of other fields where important advances improved existing unit operations or complete processes. Here we can mention new methods of heating, including the use of condenser loss effect in so-called dielectric heating, and the employment of radiation in or near the infra-red region. Development to commercial usefulness of methods of producing extremely high vacuum on a large scale played an important part in many processes essential for war—not omitting the atomic bomb. In fact, it was high vacuum on a large scale that made possible one of the new unit operations already noted, namely, molecular distillation.

Impressive advances occurred in the handling of materials, both fluid and solid. Pumps and compressors of some sorts moved years ahead, especially those developed expressly for the gas turbine and for isotope separation. In the latter case, new reliability and complete freedom from leakage had to be secured, coupled with extremely high tip speeds and low pump volume. New types of valves that would be tight in the micron vacuum range were a necessary concomitant of the high vacuum processes. In the handling of solids, although few really new ideas in equipment appeared on the scene, new techniques of use of existing equipment, plus new methods of packaging, permitted enormous strides in the handling of munitions and supplies as well as industrial loads.

In another direction, a technique that partakes of the characteristics of both a unit operation and a unit process, namely, ion exchange, came in for widespread development. Primarily this process was employed for the production of demineralized water of substantially distilled quality, but it also began to move in the direction of the purification of process liquors and the recovery of valuable components present in small or even trace amounts.

Economy in the use and conservation of energy received an important forward impetus through the perfection of the gas turbine. Employed extensively in one catalytic cracking process to recover energy from waste catalyst regeneration gases, this prime mover later went into the developmental stage in fields remote from the process industries, including power production and the propulsion of trains, ships and aircraft.

Catalysis, which is on the borderline between unit operations and unit processes, made far more advance during the war years than in any previous comparable period. Still largely empirical, catalyst development nevertheless has became more nearly a science in that better understanding has emerged concerning the role played by various elements and their combinations in the acceleration of reactions. Not only has the understanding of catalysis improved, but the production of catalysts themselves moved far ahead to permit the tonnage manufacture of several such materials, including the bead catalyst, with physical properties capable of withstanding the strains of handling in moving-bed and fluid catalyst processes.

Processes, too, progressed, apart from any improvement in the methods employed for individual steps. Sometimes this came about through the introduction of more efficient reactions, better choice of operating conditions or thermodynamic environment, or better control, but in many cases the improvement was that of making the process continuous or semi-continuous, rather than batch. It was recognized by engineers that continuity of operation is not necessarily a goal of itself, but that in many manufacturing procedures uninterrupted flow does result in superior products and lower costs.

Thus it became evident that "continuizing" is one more tool in the chemical engineer's kit, for use where practicable in the search for better economy.

Important not only in continuous processes but in most others as well was the accelerating trend toward automatic instrumentation. During the war this took two forms: the invention of a few new principles and the improvement of older ones for carrying out the functions of well-known industrial instruments; and the adapting of scientific type instruments that formerly were not seen outside the research laboratory to the needs of industry. These last served well, especially for speeding up analysis of process materials. In fact, considering the time requirements of most ordinary analytical methods, some of the war processes would have been greatly hindered, perhaps even impossible, without them.

Aside from advances that were primarily of a process nature, there were many others in fields of aerodynamic and aeronautical sciences, in electronics and physics, in power production and in other branches of engineering, all applied to military requirements. Some of these obviously will have repercussions on process techniques. Others are less obvious, but still most certainly will have eventual effects since it is difficult for progress in one science to have no influence on others.

Outstanding, of course, is the prospect for producing energy from mass by the breakdown of fissionable material. Even now in the infancy of nuclear power, it appears that it would be entirely feasible to operate a plutonium pile primarily for energy production, rather than for plutonium. Although the situation is less clear, it may also be possible, even now, to control the fission of U-235 concentrates at power productive rather than at explosive rates. One leading scientist associated with the bomb project has been quoted recently as stating that a minimum of 2 lb. of uranium would be required for such purposes, together with a weight of shielding and equipment that would be prohibitive except for large scale operations. Nevertheless, it is suggested by some that within ten years, or less, U-235 fission will have advanced to a point where it may be the subject of choice for large power projects, on the basis of economics rather than technical feasibility. It is further suggested that power, where cost is no object—perhaps for an earth-to-moon rocket—can already be secured atomically with no more than present knowledge.

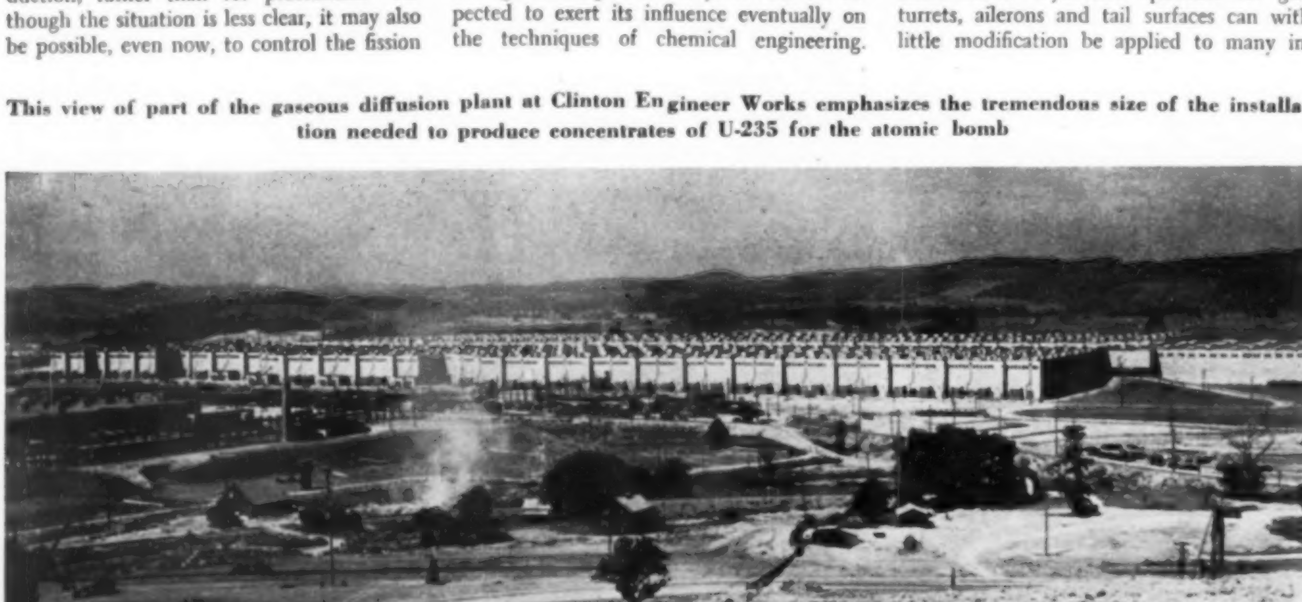
Almost as spectacular, although probably not with as widespread eventual results, have been some of the avenues opened by electronic applications. The Betatron, for example, a tool for nuclear research, also offers the utilitarian opportunity of 100,000,000-volt X-ray production for the examination of thick metal sections, such as vessels for extreme pressures. Radar in its numerous manifestations such as loran, shoran, the proximity fuse, bomb aiming, detection, navigation and the others, may not have as direct applications in process engineering, but it is certain to result in improved electronic circuits for power and heat production, industrial instrumentation and for scientific instruments. It is not inconceivable that its ability to detect and interpret events at a distance may be applied to remote measurement and control.

Almost every development in the science of flight during the war years can be expected to exert its influence eventually on the techniques of chemical engineering. Power for flight is secured by the expansion of combustion gases against reciprocating pistons or turbine blading, or by the jet reaction resulting when such gases are released uni-directionally through a nozzle. Conventional reciprocating engines, gas turbines, rocket and jet motors and combinations of these have all reached various high levels of development in the transportation of personnel and explosives to points of attack against the enemy. Although not all of these methods are directly applicable to industrial needs, their development has given us better construction materials for high temperatures and for repeated high stresses; it has improved our knowledge of nozzles, of supersonic fluid velocities, and of combustion processes.

Coincident with developments in aeronautical power supply has been the most intensive study ever given to the science of aerodynamics. Wind tunnels capable of velocities in excess of 600 m.p.h. have provided data not only to the designers of airplanes, artillery projectiles and rockets, but also for the advancement of pumps, compressors and turbines, of heat exchangers and other equipment where fluid flow is a primary requisite. Even the test equipment for high altitude flying has brought with it improvement in air conditioners, low temperature refrigeration and insulation materials, all of which will redound to the advantage of industry in general.

Nor are these the only benefits that the chemical engineer can expect to gain from what has been learned from airplane construction and operation. Fuel and lubricant research has led to general improvement in these fields. Hydraulic operators for gun turrets, ailerons and tail surfaces can with little modification be applied to many in-

This view of part of the gaseous diffusion plant at Clinton Engineer Works emphasizes the tremendous size of the installation needed to produce concentrates of U-235 for the atomic bomb



dustrial uses. Electric motors designed for applications where weight must be at an absolute minimum mean lighter and cheaper industrial motors for the future. In fact, if for any reason it may be necessary to place 10 hp. or more under a derby hat in the future, then motors of that power and size will be available.

NEW UNIT OPERATIONS

With the exception of the possibility that a base exchange process could have been used for separating the isotopes of uranium, all of the separating methods considered in the work on the U-235 phases of the atomic bomb were physical in nature and hence should be regarded as unit operations. Several methods, including centrifugal separation and an electromagnetic method of bunching and turning aside selected elements in an ion stream, were regarded as of less promise than certain others and hence were not followed to a conclusion. Three other methods, however, are all new as plant-scale separating means and at least one of them offers excellent possibilities for future use, not only in isotope separation, but for many other applications as well.

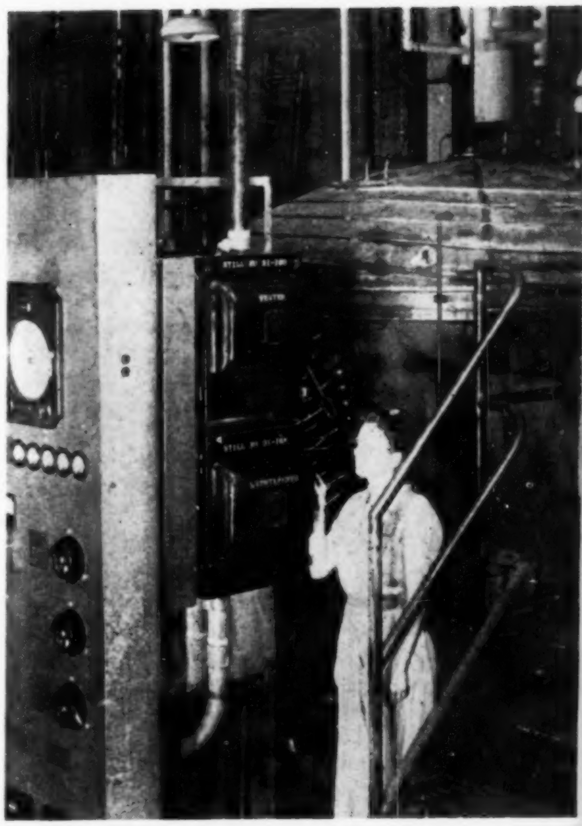
It is still impossible, of course, to make any disclosures regarding these processes that have not already appeared in published form. (See, for example, the Smyth Report, the articles by Hogerton and by Fox in our December issue, or the article by Keith that appears elsewhere in the current issue.) Nevertheless, it may be worthwhile to consider the already known facts and to attempt an appraisal, even from incomplete data, of future possibilities.

Since two of these operations are less attractive than the third, it may be well to get them out of the way before moving to the one having apparently the most interesting potentialities. These are the so-called electromagnetic and thermal diffusion processes. As has been pointed out frequently, isotopes differ in mass but not in chemical behavior and so require separation methods responsive to small differences in molecular weight. The electromagnetic method is, in essence, a blow-up of the mass spectrometer. The isotopes to be separated must be vaporized or supplied in the form of a gaseous compound which can then be ionized by a stream of high-velocity electrons so that each individual particle will respond to an electromagnetic field in a manner dependent on its mass. After ionization an electrostatic field is used to shoot the ionized particles into a curved separating tube where a cross magnetic field, perpendicular to the plane in which the tube is curved, causes particles of different mass to travel in orbits of different radii. Thus the heavier particles move in the outer orbits of lesser curvature, while the lighter seek the inner paths. By stopping the bombarding particles with separated, electrically charged targets at the end of the tube, the ions are neutralized and the elemental materials recovered in concentrated form. It may well be imagined, however, what an enormous volume of equipment must have been required for even a small throughput. The process worked successfully and produced the first U-235 concentrates, aside from minute laboratory quantities. But it is hardly thinkable that this principle will ever be considered for purposes other than isotope separation, or for its original use in the mass spectrometer.

Another of the bomb project's isotope concentration processes, the thermal diffusion method for treating liquid or gaseous uranium hexafluoride, was employed to produce a feed enriched in the 235 isotope for the electromagnetic separators. Evidently, the enrichment that resulted gave a product containing about double the original 0.7 percent concentration of U-235 hexafluoride. A large number of units was needed, which can be appreciated from the published statement that the project consumed 50 miles of nickel tubing and nearly 20 miles of 4 in. cast iron pipe. Each unit consisted of a vertical assembly of three concentric pipes, including an inner high pressure steam line, an intermediate pipe forming with the inner line a thin annular space a few millimeters wide to contain the uranium hexafluoride, and a 4-in. outer cast iron pipe to serve as a cooling water jacket. The hexafluoride, presumably in the liquid state and under high pressure, is introduced at some appropriate point, possibly the center. Owing to the presence of a hot wall inside the annular space, and a cold wall outside, upward convection flow is produced along the hot wall, and down flow along the cold wall.

Meanwhile, however, the lighter molecules of the 235 isotope tend to move by diffusion toward the hot wall, while the heavier U-238 molecules move toward the cold wall. Hence the enriched warmer stream moves upward, where a portion can be skimmed at the top of the unit. At the same time, the partially depleted colder stream moves downward, where it too is skimmed. The problems encountered included those of maintaining dimensional stability under temperature stresses; avoidance of disturbances in the liquid streams due to feed and discharge, and to parasitic eddy currents; and achievement of freedom from corrosion under bad conditions.

Obviously, if enough stages are employed in such a process, a complete separation should theoretically be possible. However, no evidence has been given regarding the number of stages used and it is presumed that the number is small, if indeed the units are actually operated multistage.



One of the 5-ft. molecular stills in the plant of Distillation Products, Inc.

Here again is a process that by the ordinary engineering standards for ordinary processes appears to be delicate, bulky and expensive to operate. Presumably it would never have been used except for the fact that by the expenditure of time, effort and money that was small compared with other phases of the bomb project, an enriched feed was made available that doubled the output of the electromagnetic plant. It appears again, therefore, that this sort of operation can hardly prove feasible for ordinary engineering use.

GASEOUS DIFFUSION

For many years the words "gas diffusion" have appeared on lists of unit operations, not because a workable method of separating gases by diffusion had ever been applied industrially, but simply because it was known from accidental diffusion and occasional laboratory work that such an operation was theoretically possible. For example, Maiers of the U. S. Bureau of Mines (U. S. Bureau of Mines Bulletin 431) at one time experimented with and advocated an interesting type of diffusive separation process that he called atmolysis. Still, to have predicted in 1940 that within a half decade many pounds of molecules

of almost equal weight were to be separated through porous barriers, would have been to arouse the utmost scepticism. Nevertheless, as everyone now knows, exactly this was accomplished in what was possibly the outstanding chemical engineering achievement, and the most notable scientific and engineering speculation of all time.

After learning something of the success with which the new unit operation of gaseous diffusion solved the nearly insoluble problem of separating two species of molecules differing by only three weight units in 350 (or less than 1 percent), one is inclined to look with more than a little interest on the means whereby this was accomplished. That the process was successful in the face of a corrosive tendency which might easily have removed all the end material from the process stream as unrecoverable corrosion products only serves to enhance its interest, since it is difficult to conceive of another sort of use where anything like so difficult a corrosion problem would be encountered.

The principles of gaseous diffusion have been described by several authors and need not be detailed here. An especially clear exposition is that given by Keith elsewhere in this issue. Suffice it to repeat the fundamental fact that the relative numbers of different kinds of molecules that will diffuse from a mixture through the holes of a porous barrier will depend directly on the relative numbers of collisions in a given time that each molecular species can make against the barrier. Since the number of collisions made by each species is determined by the average velocity of its molecules, as well as by the number of its molecules that are present, it follows from the kinetic theory that the relative diffusion velocities of two gases will vary inversely as the square roots of their molecular weights, and directly as their molal concentrations (partial pressures). This being the case, the greater the difference in molecular weights of two gases, and the higher the proportion of the lighter gas in the initial mixture, the more readily a separation can be effected.

Furthermore, additional separation can be obtained by allowing the gas that diffuses through the first barrier to diffuse again through a second, and so on until the desired separation is secured. However, it is obvious that the separating potential diminishes at any given barrier as the concentrations change, and that here is a case where only a continuous process, operated under steady-state conditions, will suffice. Therefore, the actual embodiment of a gaseous diffusion battery, or cascade as it is called in the bomb project, consists of a series of closed containers, each divided into two compartments by a porous wall or barrier, and each connected in counterflow relation to the stages above and below it in the series. Calling the direction of diffusion that from *A* to *B*, the arrangement then is that the diffused gas (enriched in the lighter component) leaves the *B* side of any stage and moves to the A side of the next richer stage, while the undiffused gas from any stage (impoverished in the lighter component) leaves the A side and joins the feed entering the A side of the next leaner stage.

Connections must be made through compressors and back pressure valves, of course, and careful instrumentation is required to maintain constant conditions and avoid pressure surges. Further than this, heat exchangers are needed between stages to remove the heat of interstage compression and permit constant temperatures to be held at any given cross section.

Thus, in such a cascade, the lighter component becomes progressively richer in one direction of flow, while the heavier component becomes progressively richer in the other. As Keith points out, the situation is comparable to that in a distilling column, or, for that matter, in a continuous liquid-liquid extraction system. The closer the separation the greater the number of distilling plates and, similarly, the greater the number of diffusion stages.

It is difficult to conceive of a more trying test of the diffusion method than was experienced with uranium isotope separation. In the first place, the desired product, $U^{235}F_6$, was present to the extent of only 0.7 percent in the feed. Then too, it differed by less than 1 percent in weight from the unwanted component, $U^{238}F_6$. For the presumably high degree of separation required, several thousand stages were indicated theoretically, which became considerably greater in practice owing to back diffusion and other departures from the ideal. To add to the difficulty, only negligible leakage could be tolerated, continuous leak purging was required, solidification of the process gas had to be avoided, and corrosion had to be eliminated at all cost throughout the system.

Contrast this situation with almost any other separation system that would lend itself to gaseous diffusion. It is hardly likely, for example, that the process would be used unless the components were gaseous at ordinary temperatures. Since the opportunities for isotope separation are few, at least at present, it is hardly to be expected that this method would be used under conditions requiring a large number of stages (close molecular weights, or low concentration of the lighter component, or both). Instead, some process based on chemical change, solution or adsorption would be probably be adopted. It certainly is improbable also that this process would be chosen if the corrosion problem were particularly severe, provided any other method were available.

Most possible applications, therefore, fall in the field of industrial gases. Kellex Corp., developer of the diffusion process, suggests as one possibility the separation of helium from natural gas, where the theoretical diffusive tendency of an equimolar mixture would be 2 to 1 in favor of helium (assuming the natural gas to be all methane), in comparison with 1.0043 to 1 in favor of $U^{235}F_6$ in the uranium separation. Only a few stages, apparently, would be needed for a commercial degree of concentration. Even more favorable would be the separation of hydrogen from most process gases since it is unlikely that any gas of lower molecular weight than methane (16 mol wt.) would be encountered in the mixture and even there a separation factor of 2.8 to 1 would be encountered. The petroleum industry likewise would seem to offer a number of possibilities among its byproduct gases, and perhaps among its normally liquid fractions as well, while in manufacture of certain chemicals, especially those employing vapor-phase catalytic reaction, synthesis gases of various kinds may some day be adjusted

Three fluid "cat crackers" built by Kellogg form the nucleus by the Lake Charles plant of Cities Service Oil Co., as shown in this air view by Fairchild

to the desired ratio for reaction by partial diffusive separation. In most likely cases this would hardly require more than a small number of stages.

What all this is going to cost in comparison with other possible methods of achieving similar results has, of course, not been revealed. Obviously, the half billion dollar U-235 separation plant is no criterion in cases where corrosion is absent, a little leakage can be tolerated through compressor seals, and a comparatively small number of stages is required. Probably the most difficult factor in the cost to appraise at this time, without specific data, is the cost of barriers. Concerning these no information other than the most general sort has been given out. That they have millions of holes of sub-micron size per square foot is known. But what they are made of and how they are made are still among the most carefully guarded secrets of the entire project.

Against the possibility that suitable barriers may eventually be produced for industry, at a cost within the range of other separation processes, must be put the fact that barrier development proved to be one of the most elusive and time consuming factors in the entire bomb project.

Still, if we are to accept the customarily reliable judgment of the developers of the process, we must believe that it will some day be competitive with other better known and time tried processes for which equipment costs are certainly not prohibitive. Unless and until there should be evidence to the contrary, it seems safe to assume that gaseous diffusion actually will become another useful device in the chemical engineer's growing kit of tools.

MOLECULAR DISTILLATION

We have already discussed three new unit operations, all devised for the separation of the uranium isotopes. At least one of these is also useful for other purposes. A fourth new unit operation for achieving separation —molecular or vacuum short-path distillation—goes back more than 20 years to the early laboratory work of investigators in several countries, but it is only within the last five years or so that development under Hickman, at Distillation Products, Inc. (*Chem. & Met.*, Aug. 1944, pp. 100-104) has overcome most of the earlier disadvantages not caused by inherent limitations, and has produced an industrial tool that can truly be considered a unit operation. Like gaseous diffusion, molecular distillation is by no means a cure-all, although its range of use is doubtless broader. In common with all unit operations there are certain purposes for which it is well suited, but beyond which other methods will yield better results at lower cost.

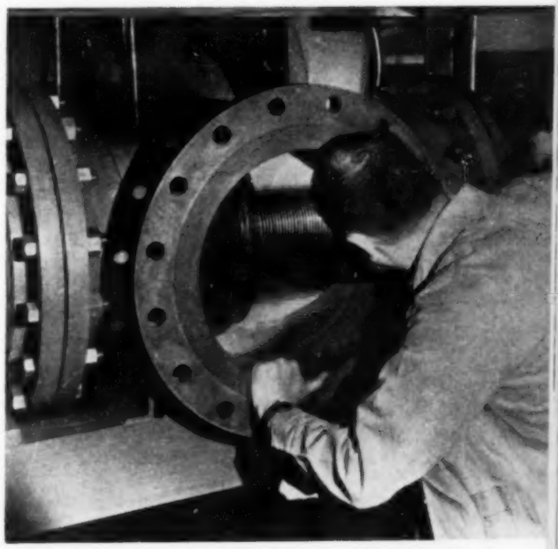
Compared with normal equilibrium distillation, molecular distillation cannot effect as complete separation in a single pass because, under the conditions in which the molecular still operates, no equilibrium between liquid and vapor is possible. On the other hand, molecular distillation can be used for purposes to which ordinary distillation is unsuited. Recalling that it is primarily a means of *concentrating*, rather than bringing about more or less complete separation, its major field lies among the heavy molecules, especially those organics that are injured or decomposed by exposure to temperatures that are sufficiently high for ordinary distillation.

Where the equilibrium still deals with lower molecular weight materials of higher volatility, the molecular still is concerned with materials in the range from, say, 250 to 1,200 molecular weight. Such includes certain vitamins, the "fixed" fats and oils, the natural waxes, many plasticizers, resins and drugs, as well as synthetic lubricants, heavy petroleum residues and many other materials. The significance of the molecular still lies in the fact that older products may now be improved by further purification, where suitable or economic methods did not exist before; while many totally new products may now be secured, even though means for their isolation were formerly not available.

Principles of molecular distillation have been described in various publications (e.g., *Chem. & Met., supra*) but it may be well to recall here the main differences from conventional distillation. All materials, even solids, have a vapor pressure at every temperature dependent only on the material and the temperature. However, this may be extremely minute at temperatures below those causing thermal decomposition. Furthermore, the presence of inert molecules in the vapor space outside the material boundary exerts an interfering effect through collisions between molecules, so that, for continuous vaporization to take place, the vapor pressure must be high enough to push back the inert atmosphere.

Obviously, if the partial pressure of inert molecules is decreased through evacuation, then the vapor pressure of the distilland necessary for continuous vaporization will decrease, that is, its "boiling point" will be lowered.

However, as the number of inert molecules is further decreased, a point is reached (in the region of 1 micron pressure) below which their interfering effect ceases for all practical purposes. Nevertheless, for every temperature a definite vapor pressure will exist for each of the species of molecule in the distilland, which is to say that the number of molecules of each that returns to the liquid surface in a given time exactly equals the number that vaporizes. The system, then, is obviously at equilibrium.



Packless stem sealing was required in the design of this National Research valve for use in the ultra high vacuum range

The task of the molecular still is to upset this equilibrium in such a way that a distillate is produced which is enriched in the more volatile constituent. Molecules can be removed from the vapor space in several ways, such as by condensation or by pumping. To remove the inert, noncondensable molecules, the still uses a diffusion or condensation pump, backed up by an ejector or mechanical pump. At the same time, to produce a distillate it places a condenser as close as possible to the vaporizing surface. Although molecules of the less volatile constituent will be condensed along with those of the more volatile, there will be fewer of the former available for condensation and hence a more volatile concentrate will be produced.

Three fundamental needs for successful distillation of heavy, relatively non-volatile materials must be recognized in the design of a molecular still: (1) To enable the vaporizing molecules to penetrate the screen of inert noncondensables and reach the condenser, the number of inert molecules must be reduced to a low point. Since these can be reduced in number only through their own diffusion from the vapor space into the pump, a short, direct and large diameter connection to a large capacity pump must be employed. This must, however, be placed so as not to trap an appreciable percentage of the vaporizing molecules. (2) Since thermal decomposition depends not only on temperature, but on time of exposure, both temperature level and exposure time must be as short as possible, consistent with the necessary capacity. However, by increasing temperature and decreasing exposure time, capacity can be increased without increasing decom-

Industrial Rayon equipment for dielectric heat setting of twist in rayon tire yarn

position, provided the third factor is recognized. (3) A molecule that leaves the vapor space and recondenses in the distilland serves no useful purpose in molecular distillation. In fact, in so doing it increases its chances for thermal decomposition. The cure is to place the condensing surface as close as practical to the vaporizing surface so that the opportunities for condensation are improved, while those for return to the distilland are reduced.

All of these criteria have been met to a satisfactory industrial degree in the late commercial designs of Distillation Products, Inc. Capacities have been pushed up to 100 gal. or more of feed per hour in the present 5-ft. diameter still, and 10-ft. stills capable of handling from one to two tank cars per day are already projected for a factory now under construction and will be built when certain fabrication problems can be overcome. Furthermore, operating costs have been brought in line with general industrial practice so that, it is claimed, it is no longer necessary to reserve this operation for treatment of valuable materials only.

The actual construction of the D.P.I. centrifugal still is most ingenious, varying somewhat with the still size. Even the smaller ones present a large vaporizing area in the form of a conical rotor over which the feed travels rapidly so as to minimize thermal exposure. In the 5-ft. model, the rotor is a truncated cone of polished cast aluminum with the small end at the bottom. With feed at the bottom center and electric heaters disposed outside the metal walls, the material is rapidly heated to the desired temperature, or temperatures, as it climbs the rotor wall toward the peripheral residue discharge. For several cuts on the same rotor, zones of increasing temperature can be employed. Close to the vaporizing surface and within the cone are condensing surfaces which also may be zoned, corresponding with the temperature zones on the vaporizing side, if several fractions are desired. Various condenser arrangements may be used, such as partial and multistage condensing surfaces and various still arrangements can be employed, depending on particular requirements, including distillate feed-back and multiple passes. Thus, almost any sort of separation in the heavy molecule field can be accomplished.

FLUIDIZED SOLIDS

Fifth among the new unit operations brought to commercial realization during the war is the process of "aerating" a bed of pulverized solid material containing properly distributed particle sizes, using for this purpose a process gas or vapor in such a way that the solids boil up and can be handled like so much liquid. As Kalbach pointed out (*Chem. & Met.*, June 1944, pp. 94-98) the roots of this unit operation are buried deep in the 19th century, but except for its use in the Fuller-Kinyon pump (and possibly in the Vertex dryer originated by the late E. N. Trump), its earlier applications failed to make a lasting impression.

During the early war years, Standard Oil Development Co. and its parent, Standard of New Jersey, revived and refurbished this old idea as a means of securing close temperature control and intimate contact between oil vapor and catalyst particles. Use was for a catalytic cracking process intended for the production of aviation fuel base stocks, plus hydrocarbon gases suitable for aviation alkylate and butadiene feed. An important advantage of the method lay in the ease with which the fluidized catalyst could be regenerated after exhaustion, by burning off the deposit of carbon while the particles were fluidized with a current of air. That the idea took hold after the first plant was completed in 1942 is evident from the fact that half the country's catalytic cracking capacity is said to be of this type and that two-thirds of the wartime construction employed the fluid catalyst principle. Two other catalytic cracking processes are also in use, one having fixed catalyst beds, one employing a moving bed that is handled by mechanical conveyors and by gravity flow.

When the process was first introduced, the hook-up of vessels required for catalyst handling was fairly complex, owing to the use of separate catalyst surge and storage hoppers following each of the two major steps of reaction and regeneration. The sequence of operations was as follows: Regenerated catalyst from a storage hopper was picked up by the oil vapor stream and carried into the reaction chamber where cracking took place with deposition of carbon on the catalyst particles. The reaction products and catalyst then left the top of the vessel and were separated in a cyclone, the vapors passing to the factionator and the spent catalyst dropping into a second hopper. From here it was fed into an air stream and carried to the regenerator where the carbon was burned off. Leaving the top of the regenerator the renewed catalyst and the combustion gases were separated in a second cyclone, the catalyst dropping to the first mentioned hopper, and the gases exiting through a Cottrell precipitator which recovered any catalyst that carried over. Temperature control of the regenerator, as well as heat recovery, was accomplished by recirculating a part of the regenerated catalyst (in part of the air supply) through a heat exchanger and into the bottom of the regenerator. Seven major vessels, including two cyclones, two hoppers, the regenerator, reactor and Cottrell were thus required.

In later plants, however, a simplification was introduced that eliminated both hoppers and external cyclones, reducing the number of major vessels from seven to three. This was accomplished by installing separators in the upper outlets of both regenerator and reactor, and providing internal flow arrangements such that the lower portion of each vessel could serve as its own storage hopper. Temperature control in the regenerator and heat recovery were accomplished as before by recirculating part of the regenerated catalyst, except that now it was withdrawn from the storage portion of the regenerator itself, rather than from a separate storage hopper.

If the use of fluidized solids were limited to catalytic reactions on petroleum vapors, the process would still be an important one. Such is not the case. We are evidently in the exploratory period preceding widespread use for a variety of operations, both catalytic and non-catalytic. Realizing that these two phases existed, Standard Oil Development Co. made arrangements with two primary licensees, M. W. Kellogg Co. for catalytic applications, the Dorr Co. for non-catalytic types of use. As it has developed, the techniques required for the two divisions of the field are widely at variance and it appears that experience in one branch, for example, petroleum cracking, cannot be extrapolated into useful design information for the other, for instance, lime burning or ore roasting.

Already at least one catalytic application for fluidized solids is in commercial opera-

tion outside the petroleum industry. This plant, built by Kellogg for Sherwin-Williams Co. at Chicago (*Chem. & Met.*, July 1945, pp. 100-1), was designed for the catalytic oxidation of 400 lb. per hour of naphthalene to phthalic anhydride. High purity of product is secured, about 99 percent phthalic anhydride, owing to uniform contact between catalyst and reactants, and the ability to secure ideal heat exchange conditions. Losses are reduced since the process operates at a lower temperature than is required in using a fixed catalyst bed. Since there is no need for catalyst regeneration, a simple set-up of internal catalyst separator and a group of external filters is all that is needed in separating product and catalyst and returning the latter to the system. Incidental advantages include lower cost outdoor construction, reduced operating costs and a reported lessening of explosion hazard resulting from the presence of suspended catalyst which is said to dissipate any possible explosion wave.

On the other side, among non-catalytic uses, considerable experimental work has been performed by the Dorr Co., although none of this is yet ready for description. Several large scale pilot plants have been constructed or are projected for the investigation of such processes as ore roasting, calcination of limestone and dolomite, and the heat treatment of other solids. As in the case of the catalytic processes, the principal advantages sought are intimate contact between gases and solids, coupled with the ability to secure extraordinarily uniform temperature throughout the solids mass.

ULTRA HIGH VACUUM

In addition to the new unit operations to which we have directed attention in the preceding paragraphs, there were certain improvements among others of the chemical engineer's tools that were mentioned in the introductory section and should be amplified here, even though they may not be unit operations. Among these are ultra high vacuum, new heating methods, the gas turbine, and developments in industrial instruments.

Ultra high vacuum, in the micron range, was not an accomplishment of the war years, but its use on a tremendous scale did date from that period, to meet demands for many military necessities including the atomic bomb, the magnesium program and other metals produced by distillation processes, lens coating, penicillin and blood plasma dehydration and vitamin A and E concentrates. Late in the 30's the condensation or diffusion pump—a molecule trap capable of functioning at pressures far below 1 micron—began its metamorphosis from a fragile glass laboratory apparatus to the tremendous metal affairs now available for evacuating speeds in excess of 12,000 liters per second at micron pressures. Distillation Products, Inc., was the first name associated with this evolution, later National Research Corp. and Westinghouse. Improvements dealt not only with size, but also with the development of pump oils of lower vapor pressure, including silicone oils (Dow and National Research), with better means of cold trapping, with multi-staging to permit higher fore pressures, and with new methods of introducing the pump oil vapor to reduce back diffusion and hence to attain higher evacuation. To permit dehydration operations under high vacuum, where the presence of large amounts of water vapor would otherwise make the pumping impossible, one important development was a refrigerated, self-de-icing condenser for installation between the pump and the evacuated space. Many of these were used in penicillin and plasma dehydration, and the same system is now undergoing test by National Research in the complete dehydration of citrus juices.

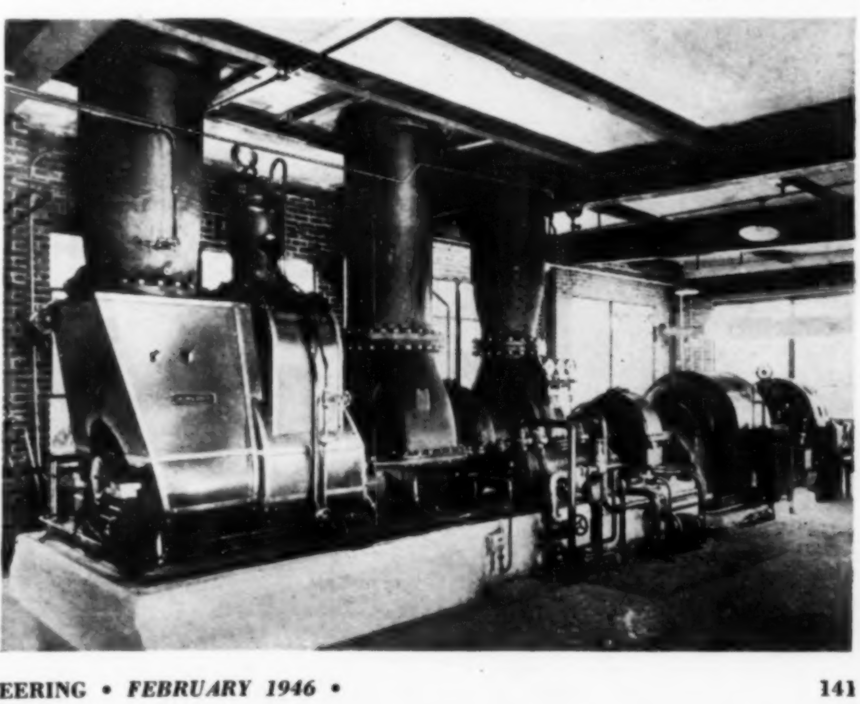
HEATING METHODS

Dielectric heating was only getting started when the war began and there were high hopes for its spread into many types of application. Actually, its progress has not been as great as was expected although the limits of its use have obviously not been reached. Earliest installations, in the bonding of plywood, continue to represent the largest use on the basis of throughput tonnage. During the war many dielectric heaters were installed for the preheating of plastic materials before molding and there is some interest evident in the use of this form of energy in the actual molding operations. Various attempts to use the method for drying met with little or no success, but the rubber industry has evinced much interest in its application for rubber curing. B. F. Goodrich Co. was one of the first to apply the process to vulcanization, while Firestone Tire & Rubber Co. has recently completed a large installation at its Fall River plant for the production of thick sponge rubber sections, such as mattresses. Dielectric heating appears to be ideal for an application of this type, since the heat is generated in place and it is therefore unnecessary to force it in from an outside higher temperature source against the resistance of a material that is an excellent insulator.

One novel application for dielectric heat applied to the preconcentration and vacuum drying of penicillin solution was developed by Radio Corp. of America in cooperation with the F. J. Stokes Machine Co. In this process water is evaporated at low temperature from the liquid state, without preliminary freezing. It is claimed as a result that both floor space and investment are much reduced. Another interesting example was Industrial Rayon's scheme of applying dielectric heat to giant cones of tire yarn after wrapping in order to set the twist.

Just what the sphere of application may be is not yet clear for another sort of dielectric heater developed in the past year by Westinghouse. Tentatively dubbed the

Installed at Marcus Hook, this gas turbine was the first used commercially in the United States, and the first anywhere for Houdry catalyst regeneration



"electronic blow torch" this device is said to hurl ultra high frequency waves against an object to be polymerized, cured or bonded, without the need for the usual metal plate electrodes either side of the object. Apparently its virtue lies in its ability to heat in restricted areas, or to be applied to irregularly shaped pieces of material without the danger of electrode scorching.

Infra-red heating also saw further development and application in recent years, although this was chiefly in the drying of paint films on military goods and vehicles. To some extent it was applied to process drying, but usually in conjunction with air circulation or with convected heat. Infra-red generators have the advantage of applying heat rapidly at a relatively low temperature. By the same token, the method appears to be most suitable for applications where only surface heating is desired.

It is questionable whether there has been any major development in new heat transfer media during the war, other than the widespread use of sodium in the cooling of airplane valves. Many new applications have been made in petroleum industry processes such as Houdry and Thermofor catalytic cracking, and in resin kettles and other high temperature operations. What is believed to have been the first use of Dowtherm in sulphuric acid concentration occurred in the three 30,000,000 B.t.u. vapor generators for the Simonson-Mantius concentrators installed at the synthetic ethyl alcohol plant of Standard Alcohol Co. at Baton Rouge.

GAS TURBINES

Certainly in any discussion of general engineering development, the gas turbine should stand near the top of the list, if only because it is the sole form of internal combustion machine that approaches the diesel engine in thermal efficiency. Compared with a steam powered turbine, it needs no steam boilers and no condenser water. Compared with internal combustion engines of other sorts, it is more versatile and can be built in larger sizes. Compared with any other sort of prime mover, it offers greater flexibility of use and more opportunities for fitting into a process flowsheet.

It was primarily because of an application of the last type, where waste heat was involved (Tucker, *Chem. & Met.*, Mar. 1944, pp. 96-100), that there has been more gas turbine horsepower installed in the United States since 1937 than in all other countries combined. The reason lies in its adaptability to the Houdry catalytic cracking process which requires enormous quantities of compressed air for catalyst regeneration, but gives off a large amount of waste heat in the resulting flue gases. The hot waste gas is allowed to expand through a turbine, producing enough energy to compress an equivalent amount of fresh regeneration air in an axial flow compressor. Since there is an excess of power remaining after the air has been compressed, the balance is absorbed in operating a generator.

Of more than 30 units devoted to this purpose, a few were constructed by Brown, Boveri of Switzerland, the first firm to produce a successful modern design; and the remainder by Allis-Chalmers Mfg. Co. More recently, the Elliott Co. has entered the field with a marine propulsion unit for the Navy. Elliott brought a new positive rotary compressor, the Elliott-Lysholm design, into the picture, to compete with the axial flow designs used by others. At present the United States has no gas turbine installation built exclusively for power, although the future will see this method applied to that purpose, as well as for marine and railroad propulsion, which are now experimental. Until materials of construction permit turbine temperatures to be pushed well above the approximate 1,200 deg. limit at present necessary, toward the 1,500 or even 1,800 deg. limits that designers are discussing, it appears that process applications similar to the Houdry, where at least some waste heat is available, will be among the most attractive.

INSTRUMENT DEVELOPMENTS

Wartime industrial and scientific instrument development has been so extensive that it will be possible here to mention only a few outstanding trends. Among industrial instruments much of the advance has been in improved electronic measuring circuits, either to reduce the number of moving parts, or to eliminate them almost entirely. For example, some circuits dispense with the usual galvanometer, making various ingenious substitutions for it, while others take any responsibility for making contacts or balancing movements from the galvanometer, leaving to that device only a detecting function. In that connection, it is interesting to learn that the General Electric Co. has developed a new method of suspending moving elements magnetically. This means that the jewelled bearings will merely guide the element, rather than to have the dual functions of guiding and supporting. Applied to moving coil meters and galvanometers of all sorts, this principle should result in a substantial increase in sensitivity.

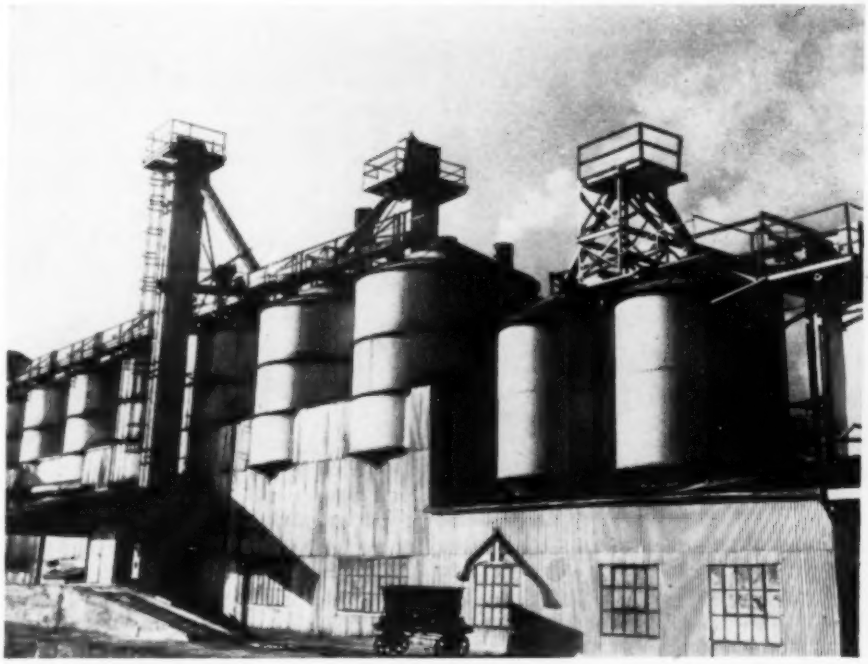
Measuring methods for industrial instruments have changed little during the war years, unless we include as industrial some of the scientific types to be mentioned. In the main, the same general sorts of systems are being measured (or measured and controlled) by the same general means as in 1940. The mere fact that the potentiometer used may now be electronic rather than mechanical does not alter that fact.

Portion of the control panel in a Thermofor catalytic cracking plant that was built during the war for aviation gasoline by E. B. Badger & Sons Co.

There are, however, a few new or formerly little known detecting systems in which there is evidence of interest. For example, high vacuum technology has brought out modern industrial versions of the Knudsen, Pirani and ionization gages, and has greatly improved the McLeod gage. One unexpected source for a temperature or pressure sensitive element is the strain gage made by Baldwin-Southwark and used by the thousands during the war for testing the deformation of airplane structural members while in flight. This is a fine-wire resistance element which changes its resistance in direct proportion to changes in length of the material to which it is secured. By using the element to measure deflection of a diaphragm it becomes a pressure gage, suitable for thousands of pounds—or for ounces. By using it to measure thermal expansion, it becomes a thermometer.

Many types of industrial instrument were frozen in design and others were discontinued for the duration. Perhaps the greatest number of variations brought out in connection with any one fundamental principle was in area type flow meters. Fischer & Porter Co., for example, introduced a new rotameter bob compensated for viscosity changes, thus overcoming a disadvantage of that type of instrument. Conversely, the same concern developed a continuous viscosity meter based on the rotameter, using constant flow and an uncompensated bob. Many other modifications of the basic rotameter design were brought out, some with the usual tapered metering tube, others with a new tube having V-port flutes in its sides. By means of electronic amplification, this manufacturer succeeded late in 1945 in controlling flows down to 10 cc. per minute with a rotameter having an induction coil detecting system. Detecting current used was so minute as to have no reciprocal action on the float, yet it could be amplified to operate a $\frac{1}{4}$-hp. motor.

Most striking of the wartime trends in industrial instrumentation was the adaptation for industrial use of certain devices that had formerly been used only for scientific research. Largely, these instruments were employed for analytical purposes (*Chem. & Met.*, July 1945, pp. 119-126). Among them, the mass spectrometer made perhaps the most notable advances, because of its extensive use in connection with the atomic bomb, not only in earlier research, but also in the building and operation of the plants. While Westinghouse and Consolidated Engineering Corp. were concerning themselves with instruments of this principle for hydrocarbon analysis in the petroleum and synthetic rubber fields, General Electric was concentrating on the bomb plant mass spectrometers. One, the so-called "leak-detector," was a simplified portable instrument rugged enough to be used by semi-skilled operators in the field. Another was designed for continuous analysis of plant fluids. Still another, presumably for research, was made so sensitive that it would detect one part of a gas in 100,000 in the mass range from hydrogen to mercury, with lesser sensitivity for higher mass numbers.



Typical of a modern raw materials storage set-up is this one where all materials for Fiberglas are handled in the Owens Illinois plant at Newark, Ohio

Other means, also, were developed extensively for rapid and sometimes automatic analysis and control, especially for metals, vitamins, pigments, catalysts, hydrocarbons and inorganic salts. Representative of these instruments were the polarigraph, the emission spectrograph, the infra-red and ultra-violet spectrometers, the Geiger-counter X-ray spectrometer and a variety of improved photometers for analysis of color transmission or reflection in the visible light range. Some of these devices cut many hours from the analysis time required for conventional methods. Absorption spectrometers of both the infra-red and ultra-violet types have already been applied not only to analysis but to automatic control. Refractive index, too, was a property that was applied in a few instances to automatic analysis and control.

Even more unusual was the scheme developed by the Texas Co. for using gamma rays from a radium salt in a small needle to measure the thickness of metal tube walls as a means of determining the extent of corrosion loss. The method was also employed to detect the level of liquid inside a tank. Use is made of the fact that some of the rays that penetrate the wall will be "back-scattered" and can be picked up electronically and their intensity measured. This intensity depends on the wall material and its thickness, but also on whether liquid, or a gas or vapor space, is backing up the wall.

OTHER UNIT OPERATIONS

Reference has already been made to several new unit operations, and to important progress in supplementary engineering procedures. In the main, development among the unit operations is generally slow. As it happens, it was also slow in many types of equipment during the war, on account of material restrictions, general short-handedness and the necessity for concentrating on other things. Many ideas under wraps in the past few years are expected to blossom forth speedily in the next two.

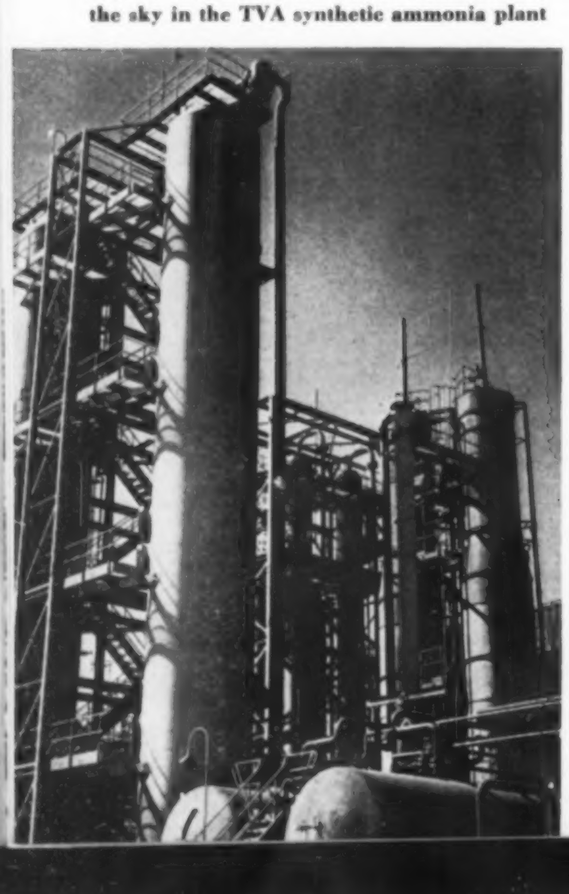
It should not be construed from these remarks that improved types of equipment were actually not introduced in considerable quantity. It is true, however, that the great bulk of the improvements actually put into use were evolutionary, rather than revolutionary. It will be our aim here, therefore, to survey briefly what the principal recent trends have been in the most important unit operations and their equipment, as well as in a few other fields that have a direct bearing on chemical engineering activities.

Materials Handling—Very little that was actually new appeared in materials handling equipment, although in the techniques of handling, impressive improvements were

made. For example, in bulk storage and reclaiming, especially for coal, practice was borrowed from the civil engineering profession in the use of the bulldozer and carryall. The armed services made tremendous strides in the handling of all sorts of packaged materials, as well as articles of unit nature, such as projectiles. As has been outlined recently (*Chem. & Met.*, Nov. 1945, pp. 119-130), this development was largely one of palletizing and the evolvement of "unit loads," coupled with package standardization and simplification. In this the pallet lift truck played a remarkable part that will continue to gain industrial acceptance during the peacetime years ahead.

Fluids Handling — Pumps, compressors and valves all shared in a considerable degree of advance, much of it claimed to be in connection with the atomic bomb plants. There was a marked trend toward the use of mechanical seals rather than packing for centrifugal and rotary pump and rotary compressor shafts, and also toward the complete elimination of mechanical sealing contact through use of centrifugal seals, as in the LaBour Type G; submerged motors as in several Byron Jackson pumps and a few others; or induction drive as in one of the bomb plant designs. The already noted trend toward expansion of ultra high vacuum technology resulted in development of extraordinarily tight valves for these purposes, as well as vacuum tight packing methods for rotary shafts. Many of the bomb plant valves were of special leakless designs, with bellows or other novel seals replacing packing. Improved methods for field fabrication of plant piping had to be developed, and new testing methods were required to insure detection and repair of all leaks. An unusual valve, the Grove Flexflo, was brought out employing a rubber sleeve that is opened or closed against its seat by the pressure of the fluid itself, applied through a small pilot valve to a chamber outside the sleeve.

Carbon dioxide removal towers reach toward the sky in the TVA synthetic ammonia plant



Gas turbine development did much to advance rotary compressor design, resulting in both axial flow and centrifugal types of improved efficiency. Introduced for the same purpose, the new Elliott-Lysholm compressor is a positive rotary type with dual rotors of most unusual shape, said to have superior characteristics where a comparatively high compression ratio is required. Compression takes place progressively during passage through the rotors.

Disintegration—A number of original designs of grinding machine appeared, although as yet several of these have had insufficient use for final conclusions. The trend toward extremely fine grinding has continued, occasioning several new schemes. For example, Eagle Pencil Co. evolved a fine grinder consisting of a long pipeline through which the material to be ground is conveyed pneumatically, grinding being accomplished by friction of particle on particle. Joseph Dixon Crucible Co. coupled the pipeline idea with a high velocity cyclone and air elutriation. Raymond Pulverizer placed an impact mill on end and employed a 3 ft. diameter rotor at 3,600 r.p.m. With bottom feed and through air circulation, the exit of oversize is prevented by use of a double whizzer. Pulverizing Machinery Co. developed the Mikro-Atomizer, an air-swept impact machine with a novel arrangement of dual separator wheels, designed to reject oversize and return it to the grinding element by opposing actions of centrifugal force and aerodynamic drag.

For fine grinding in a somewhat coarser range the DeAnza mill grinds by attrition of the feed against a part of the material itself contained in a rapidly spinning cup. The D'Ore mill uses a single heavy roll free to rotate on the inner surface of a cylindrical cage that serves both as the mill body and as a 360 deg. peripheral discharge screen.

In the paper industry, hydraulic debarking of logs became a reality, bringing with it large savings in labor and time, coupled with waste reduction.

Mixing—Few equipment developments occurred in this field, although many new ways of using mixing equipment were worked out successfully. Considerable effort was devoted to the rationalization of this unit operation. Nevertheless, art still remains at least as essential as science. Most of the newer forms of agitating devices installed during the war had actually been developed previously. Among the latest of these may be mentioned the Turbo gas contacting impeller and the Turbo saturator; the Patterson Centri-cone; the Mixing Equipment disperser and the Struthers-Wells Brumagin high speed propeller.

Heat Transfer—Little of the development in heat transfer equipment in the war years can be called strictly new, so far as can be seen at present. However, modifications and extensions of existing types were frequent, especially in devices employing extended surface tubing. Pending the release of more information on the bomb plant heat exchangers to permit appraisal of some broad but unsupported claims that have been made, the most striking developments probably cannot be selected. In any event, among them will be found the elimination of need for heat transfer, in dielectric and electronic induction heating. Another will be the improvements already noted in connection with fluidized solids technique.

So far as engineering is concerned, much effort was devoted to the securing of more and better heat transfer coefficients. The study of heat transfer in complex cases was markedly advanced through the development of two methods of using "models" and electrical analogies at Columbia University's Heat Transfer Laboratory (*Chem. & Met.*, Dec. 1943, p. 111). One valuable piece of specialized heat transfer equipment, the Votator, first available a number of years ago for food industry uses, has since proven helpful in the heating and cooling of viscous materials in the chemical field.

SEPARATION OPERATIONS

By far the most numerous of the unit operations are those concerned with separation. Broadly speaking, these fall into groups of phase change, electrical, mechanical, hydraulic and settling operations which will here be discussed by their principal subdivisions.

Extraction—This unit operation developed rapidly from an application standpoint in the war years, with the emphasis on continuous counter-current extraction, both in towers and in series of mixing vessels alternating with separators. Numerous engineering data are being accumulated although the field still has far to go in this respect. In fact, except for the extension of applications, the situation is still largely that summarized by Elgin in 1942 (*Chem. & Met.*, May 1942, pp. 110-116). One particularly significant application has been the plant scale use of extractive lumber drying in which recovered resins are said to pay the cost of operation.

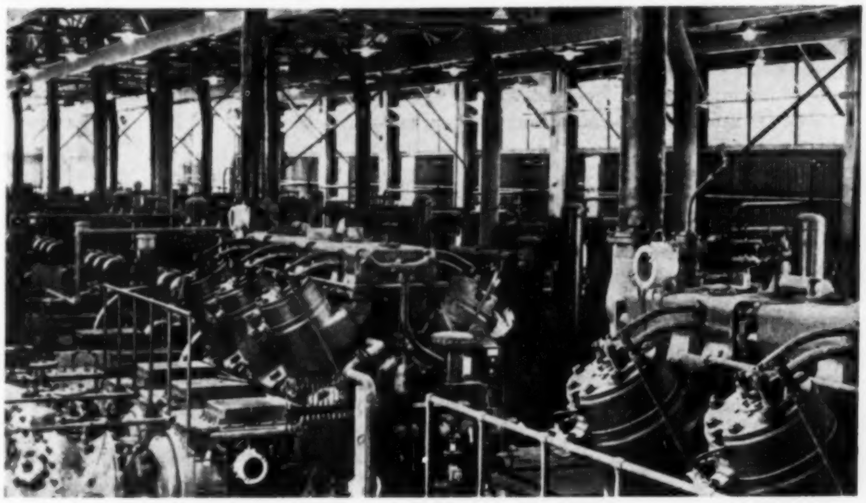
Crystallizing — Crystallizing has moved largely from the open agitated tank crystallizer toward the vacuum cooled type, both with and without seeding. This is a logical

result of the trend toward larger crystals, as well as further appreciation of the advantage that the vacuum crystallizer has in permitting rubber lining and requiring no heat transfer surface. Some progress, although not a great deal, has been made in the theoretical phases. For example, in solving the important problem of producing ammonium nitrate that will not cake in storage, it has been appreciated that there are five crystal forms of which only one is stable at ordinary temperatures. Crystals thrown down above one transition point, but stored below that temperature, will cake. By crystallizing below the critical temperature of 32 deg.C. and coating with inert material, the problem has been met satisfactorily.

Distilling—Commercial development of molecular distillation, which should probably be considered as a separate unit operation, has been described on an earlier page. In the field of rectification there were a number of developments of interest. The use of azeotropic distillation has increased markedly and a somewhat similar process, extractive distillation, has come into the picture. Here a solvent which is less volatile than the components to be separated is used in the still and has the effect of depressing the less volatile component by altering the relative volatility of the several component materials. One of the most striking wartime developments was the use of glass fiber column packing to assist the alcohol industry in meeting the tremendously increased war program. By this and other means a minimum of new construction was needed in converting beer stills to 95 percent alcohol columns. Used first as an expedient, it seems likely that glass packing will continue to enjoy considerable use in distilling columns and other contacting equipment.

Evaporation—Evaporator design, except in details, has seen little change in recent years. Design alterations were required at times, owing to a shortage of preferred construction materials, and there has been considerable use of Karbate tubes and rubber linings as a result. To a small extent Dowtherm is now being used for heat supply in nickel tube circulating evaporators for caustic concentration.

A direct military application was responsible for the successful adaptation of an old and previously little used idea, that of vapor recompression evaporation. This was the single-effect Kleinschmidt evaporator of Arthur D. Little, Inc., (*Chem & Met*. Jan. 1946, p. 129) which was built by the hundreds for the Navy to produce distilled water from sea water at an economy said to equal that of a 15-effect evaporator. In the latest models, it is claimed, 175 lb. of water is produced for each pound of fuel expended.



Essential element in many processes, these engine-driven angle compressors are installed in the government owned butyl rubber plant at Baton Rouge, La.

Drying—Aside from increased use of infra-red heat, little that is new in drying appeared for chemical industry use during the war except for the freeze drying processes used for blood plasma and penicillin. Introduced by F. J. Stokes Machine Co. as the Cryochem process for plasma and similar dehydration several years before the war, this method came into large scale use. Essentially it consists in the high vacuum vaporization of moisture from frozen, heat-sensitive materials. As already noted, it was later found possible by Stokes and R.C.A. to dehydrate penicillin without freezing through the use of three stages of vacuum drying employing dielectric heat.

Adsorption—The principal development of recent years in the field of adsorption has been the advent of lower cost adsorbents such as activated bauxite and clay. Use of adsorbents increased mightly in the drying of process gases and especially in the employment of silica gel in the packaging of military materiel that would be harmed by excessive humidity. Another important new application for the adsorbent carbons was as an adjunct to air conditioning systems for the removal of odors, with consequent reduction in the necessary fresh air intake.

Filtration—Filter improvement has tended to move in the direction of specialization in recent years, with the development of filters adapted particularly to rather narrow classes of materials. Several types, for example, were introduced specifically for quick settling materials, including the Oliver horizontal rotary filter and the Peterson Synchro-Drum. The former is essentially an automatic continuous nutsch filter in which an annular rotating trough containing horizontal filter leaves that form its bottom receives the wet material at one side, filters and washes it during rotation of the trough, and then discharges at a point near the feed by means of a rotating scroll or other suitable discharger. The second filter mentioned is a double-drum filter resembling a double-drum dryer, with the feed trough formed by the vee where the drums touch. An added advantage if slime is present is that filtering occurs before the filtering surface moves into the slime zone, thus avoiding cloth blinding. Another new Oliver, the panel filter, is adapted to dilute feeds, slow filtering materials and a thin cake. No wire winding is used, each panel of the drum being clothed separately with the cloth caulked in. Very light air pressure for discharge, coupled with a cross-wire cake cutter, serves to detach the cake.

Centrifugals—Recent years have seen considerably increased interest in continuous centrifugals of both filtering and settling types. The Bird settling type, for example, has been adapted to use as a classifier for fine separations at small particle sizes. Valve and nozzle continuous-discharge bowl machines of the high speed type have been introduced by Sharples, DeLaval and Merco, while there has been continued interest in the automatic cycle-controlled, semi-continuous bulk machines such as the Baker Perkins ter Meer and the Sharples automatic.

Settling and Flotation—Most of the more recent advance in settling type separators has occurred in sanitation, sewage and water treatment, where the gains have consisted mainly in the improvement or combination of well known elements. Greater attention has been paid, for example, to methods of feed flocculation to increase settling speed, sometimes in a pretreatment section of the settling apparatus. An example is the Dorr Clariflocculator in which a flocculation compartment equipped with a mechanical flocculator is built concentric with the settling tank and discharges to it at the bottom.

"Sludge blanket" units used in water treatment similarly combine flocculating and settling.

A new principle in flotation apparatus appeared in the form of a method capable of separating solids of specific gravity close to that of the liquid in which they are suspended, either from the liquid alone, or from both the liquid and any denser solids that may be present. In the case of the light solid, separation is accomplished by attaching air bubbles which float the material to the surface for skimming. The clear liquid then overflows peripherally while any heavier solids are removed by settling. The Dorr Vacuator and the Adka and Pederson savealls operate on this principle. Bubble attachment is caused by pre-aeration followed by pressure reduction.

In the class of concentrating methods for which the name flotation is ordinarily reserved, there has been little change in fundamental equipment types, but widespread gains occurred in application and techniques, especially in the recovery of war-important minerals. Among these may be mentioned feldspar, barites, lithium salts, fluorspar, scheelite and magnesite, as well as limestone concentration for portland cement. Extensive use continued of course, in phosphate rock and potash operations, as well as in the handling of the sulphide ores normally concentrated by this means. Owing to potential exhaustion of our high grade iron ores, flotation and other concentration methods for improvement of lower grades were intensively investigated.

Classification—Perhaps the most novel development in the general field of classification was the Humphreys Spiral concentrator (*Chem & Met.*, April 1945, pp. 107-9). Employed on gold, chromite and titanium minerals, this development of the Humphreys Gold Corp. uses gravity-induced centrifugal acceleration, rather than straight gravity settling, to separate denser from lighter minerals. A spiral channel of semicircular cross section is used to chute the material, suspended in water, from a higher to a lower level. Owing to frictional effects similar to those in a river rounding a bend, heavier particles concentrate toward the center (surprisingly enough) and may thus be skimmed off. Similarly, a middling may be separated from the lighter material, while the tailing follows the greatest radius.

Modification of the Fahrenwalt sizer made available the Dorrco sizer which is a closely controlled hindered settler that has been used during the war in further improvement of iron ore concentrates and in the classification and also recovery of abrasives. This device employs a series of settling pockets with automatic discharge of settled material and controlled upward flow of hydraulic water. Water velocities decrease progressively from the first (feed), to the last compartment.

AND IN CLOSING . . .

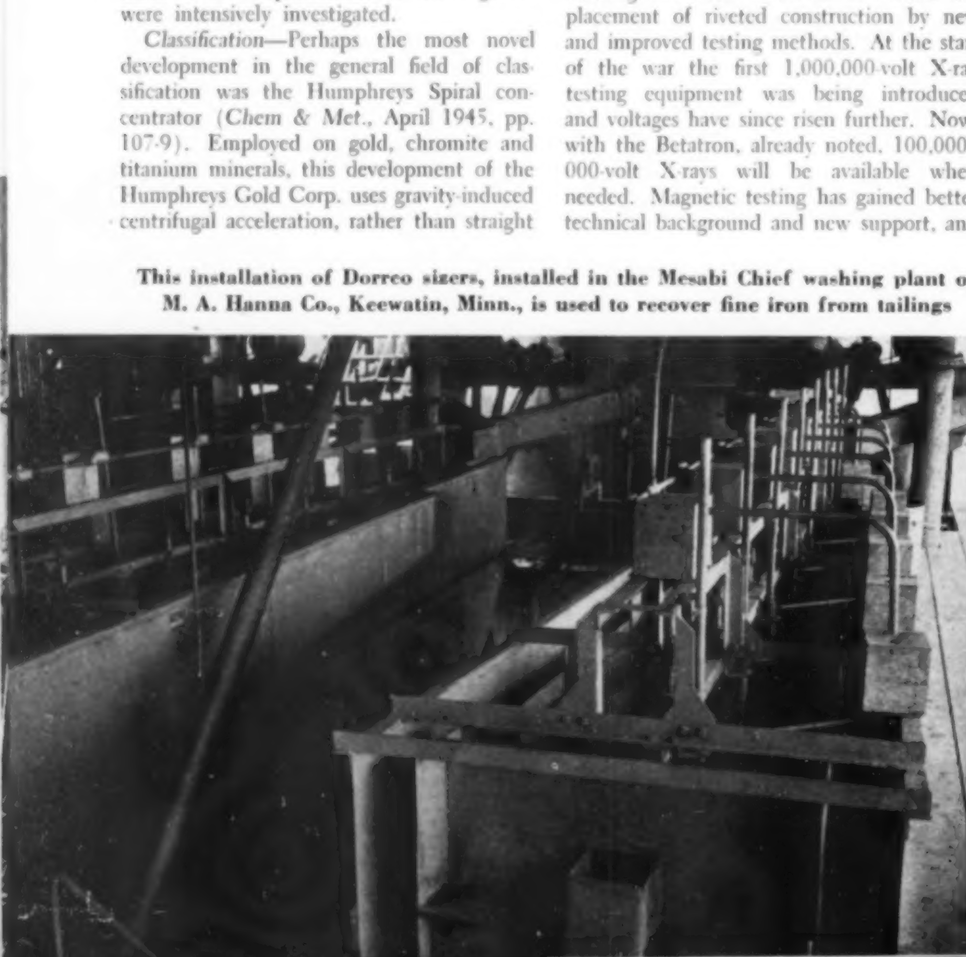
Before ending this discussion, a few remarks should be appended concerning materials of construction and a number of miscellaneous developments that have resisted classification in the groups listed above. Among the latter we should mention several improvements that have aided in equipment production. Automatic welding machinery has made notable progress and welding has been aided in its virtual displacement of riveted construction by new and improved testing methods. At the start of the war the first 1,000,000-volt X-ray testing equipment was being introduced and voltages have since risen further. Now, with the Betatron, already noted, 100,000,000-volt X-rays will be available when needed. Magnetic testing has gained better technical background and new support, and another non-destructive method, the Zyglow process was introduced for thinner walled vessels. A fluorescent penetrating chemical said to find its way through minute faults and pin holes has been developed, to be painted on seams and suspected points, with any penetration detected by black light.

There were of course important innovations in construction materials, some simply substitutions for wartime metal shortages, but others of lasting value. Impervious carbon and graphite made remarkable strides and appeared in several types of standard equipment, including heat exchangers, valves, pumps and pipe, put out by National Carbon. Dow's plastic, Saran, gained widespread use in pipe, tubing and fittings in addition to its monofilament uses in consumer applications. Glass offered new opportunities in several directions including plastic-reinforced fabrics, not only for cockpit and body armor, but for corrosion resistant ware; Foamglas not only for Navy floats, but for low temperature insulation; heavy plate, not only for architectural use but for heavy tanks requiring acid resistance; and new fabrication methods for glass piping. The latter, developed by Corning, facilitate field production of joints, one method being a simple beading procedure for the pipe ends, the other a high frequency welding method for attaching conical flanges. New glasses were also brought out for special purposes, for example, a silica-free phosphorus-based glass that resists the action of HF, announced by American Optical Co.

Probably the most widespread eventual results of any recent innovation in construction materials will come from the family of the silicones that emerged from the curiosity stage during the war. Greases and oils for temperatures from low to high, heat resisting insulations for high-load motors and other electrical equipment, water repellents for insulators and hydrophobic filters, and high temperature rubbers for gasketing and similar purposes are only a few of the directions in which these materials are traveling.

Aside from the impoverishment of alloys to save critical metals, developments in metallic construction materials were not numerous. One that should be mentioned, however, is the Bart process for internal nickel plating of pipe. Mechanical working after deposition of a thick nickel coating is believed to be the secret that permitted use of this material, in pipe diameters up to 18 in., for purposes that formerly could use only nickel tubing.

This installation of Dorrco sizers, installed in the Mesabi Chief washing plant of M. A. Hanna Co., Keewatin, Minn., is used to recover fine iron from tailings



Reprints of this 24 page report are available at 25 cents per copy. Address Editorial Department, *Chem & Met.*, 330 West 42nd St., New York 18, N. Y.

B. H. HOPKINS *Chemical Engineer, Detroit, Mich.*

TIMMIE

Versus Industrial Psychology

Chemical engineers work with materials and methods, and they accomplish first-rate results through their control over these two industrial media. But their record in another medium, men, is not so successful and distinguished. Psychologists, on the other hand, are students of human material and have developed excellent techniques for handling men in industry. Chemical engineers must catch up with these accomplishments in psychology if they are to take their next great stride forward in usefulness and importance to the industry.—Editors

"Of all the dirty deals—"

TIMMIE TEASQUARE definitely doesn't like the thought of once more being omitted from the promotion lists of the Engineering Division of 5M Manufacturing Co. So when George, the valve hand, mentioned Skinny Iffis' name, Timmie's feelings reached the bursting point. Timmie had been headed back to the power sub-station on Skinny's first request for engineering data when George invited Timmie to the current gripe session in Maintenance. To be reminded of the man whose promotion rankled Timmie so thoroughly just at a time when he was rebelling against orders, unlocked the flow of Timmie's grievances.

"The only reason I hung around this place after the war was because I got wind of the Old Man wanting to retire. I thought when he got out of the way, I'd get a chance at something decent. Willie Winslow and I had been around here just about as long as anyone—at least as long as any of the Ch.E's —and we thought one of us ought to have a crack at the Old Man's job. Maybe the Brass thought they had to bring in an outsider, but I can tell you it's no bed of roses trying to work for that Personality Kid they hired away from Continental. But when the Kid took Willie and Skinny on as Assistant Chiefs—that burns me up."

"Yeh, it's tough," George chimed in. "Skinny hasn't been around here very long, has he?"

"I never saw him until six months ago," Rawson volunteered. Rawson was the gage repairman for Maintenance.

"Aw, he's been around here longer than that," Timmie answered, "He came here late in '41 when they expanded Design. But Willie and I came here almost 14 years ago. I even have three hours seniority."

"That's figuring too close on seniority, Timmie," George cut in, "Labor Relations won't allow less than a day."

He shifted his chaw to the other cheek before breaking into the awkward silence, "You shouldn't have too much trouble with Willie. He always looked square enough to me."

GREEN EYED MONSTER

"Willie isn't so bad," Timmie acknowledged. "If there have to be two good jobs, I don't mind Willie getting one. But you don't know how he's been getting the breaks. The Old Man took his last six designs and none of mine. How would you like them apples, George, to have six straight jobs chucked in the files? Jobs that are right down my alley, too."

"Is Willie really the Old Man's nephew?" Rawson queried.

"Naw, no relation at all," Timmie continued. "But I bet that Personality Kid is. Naw, Willie gets a lot of inside dope from the Super and a couple of foremen by playing stoolie. Willie was an awful sap when he first came here, running errands for the Old Man, chasing special samples through Process that the foreman could take care of. Willie just started out being a stooge. But that Skinny. He's a plain punk. Always listening to the bull the bosses hand out. Trotting his legs off to read meters for the Old Man. Writing reports for the Management. He's a bigger politician than Willie ever dreamed of being. The way Skinny goes around the shop poking his nose into everyone else's business, you'd think he'd have it punched clean off his face by now. But the foremen must think he's the Wonder Boy himself, the way they do his dirty work for him when they won't do a single job for me the way I want it done."

"Yep, I can see how it goes, just from the way the boss plumber handles his government work," George agreed, "You sure have to put up with a lot of no-cooperation around here."

A quick glance at his watch snapped Timmie back to the object of his errand.

"Jeez, George, tell me how the water pressure is holding up back in Department 92."

"Haven't been back there for a coupla days, Timmie, but Herman was telling me this morning that there wasn't any complaints."

"Thanks a lot, George, that saves me a

long hike back to the lot line. I'll just have time for a cup of coffee with Gertie before punching out," Timmie sang out over his shoulder as he started on his way.

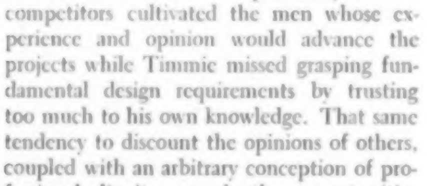
WHAT'S IT MEAN?

While Timmie detours back to the office, let us see what this commonplace bull session signifies. If Timmie were the only unpromoted man in industry, if he were the only transgressed-against figure in the engineering world, if he were utterly incompetent—then he would not be important enough to merit our attention. But Timmie is not exceptional. His very commonness justifies dissecting his behavior. His characteristics permeate the industrial structure so widely and so insidiously that we barely pay his counterparts any serious attention.

Plainly, Timmie is disgruntled. He has not received a promotion that he thought he merited. He shows a growing contempt and distrust for two colleagues who have been advanced, one man a longtime associate with whom Timmie should have established harmonious relationships, the other a junior obviously on the make. Timmie has developed few solid friendships among his associates. Jealousy rides rampant in his competitive projects, abetting six straight losses to one man whose work was accepted. Yet Timmie overlooks the possibility that his competitors cultivated the men whose experience and opinion would advance the projects while Timmie missed grasping fundamental design requirements by trusting too much to his own knowledge. That same tendency to discount the opinions of others, coupled with an arbitrary conception of professional dignity, reveals the opportunities Timmie passes by in the forward progress with his colleagues. His mental reservations shut him off from legitimate assistance that cooperators give one another. Finally, Timmie fails in line of duty when he accepts hearsay evidence about a matter he was assigned to check himself.

To his organization, Timmie's day by day work habits have shown him unsuitable for further development. He lacks the qualities of judgment, imagination, and cooperativeness needed in the positions to be filled. Timmie hasn't shown possession of the attributes that could make him overcome the obstacles blocking the conquest of his

**"Thanks, George.
That saves me a long hike."**



difficulties. Timmie has ceased to be an important man, useful, yes to a limited degree, but not one destined for further advancement at 5M.

To a psychologist, Timmie represents a maladjusted personality, a person out of tune with his environment. Any one of several causes may be responsible for the poor fit. His aptitudes and interests may have been such that, although his intelligence could master the principles of his science, the urge to apply that knowledge is missing. His mental capacity may be very great along specialized lines yet decidedly inferior in the broader areas of knowledge. Timmie may have had poor guidance or met unfortunate circumstances when he started his first professional assignment. He may have had an introverted personality unsuited to team work, yet been forced to work for a domineering boss. But whatever the past causes may have been, Timmie now shows a serious maladjustment. He feels overpowering frustration. He continually loses interest in work. He is progressing through several stages of rebellions and mental sitdowns to a demoralization that ends in breakdown. Already he is at an unproductive level.

TIMMIE'S A NO. 1 GUY

To an engineer dabbling in psychology, Timmie is a typical No. 1 Guy. The strongly egocentric pattern of his thinking demands that events and surroundings pivot on his whims and decisions. His ambitions demand fulfilment whether he possesses the necessary talents or not. Rewards for the tiniest of services must be forthcoming promptly and generously. While life flows on around him, a No. 1 Guy fights to retain all the prerogatives of fluctuating moods and temper outburstings. His self-concern ruins any objective evaluation he might make of his own strong qualities and weak points. He strains to cover up his ignorances lest they be discovered and charged against him. His mental growth has yet to reach the point where he realizes that, because the sum total of knowledge lies beyond the capacity of any human being, the fragment that he possesses has more value as a component than as a whole. He feels that his fellow men distrust him, yet never inquires into the reason. He senses indifference of others toward him, but doesn't realize that he erects the barriers to friendliness. He owns a full set of prejudices, no one of which will he part with knowingly. Altogether his preoccupation with his own position in an egocentric pattern of thinking and behaving, makes him unfriendly and friendless, uncooperating and uncooperated with. It is impossible to miss the No. 1 Guy characteristics motivating Timmie.

This breed is not confined to engineers and scientists. All occupational groups possess their quotas. Yet industry must build its organizations out of No. 1 Guys,

"Tsch, tsch, tsch"

for they are the principal source of human material. A place like 5M must integrate men like Timmie as best it can. 5M takes its name from Materials, Machines, Methods, Money, and Men. Its staff must have mastery over all of these components. Most of its personnel are expert in the detail of a single M. Many acquire skill in combining 2 M's. Quite a few persons really understand the interplay of 3 M's. But when it comes to blending 4 or all 5 of the components, the list of competent members shrinks to a handful—the few upon whom the many depend for so much. In those higher blends of 3, 4, and 5 M's, one factor tends to overshadow all the others, namely, skill in handling Men. The human race produces a very limited number of men possessing natural talents for leadership. 5M must fight to find its meager share of these individuals, must then strive to develop skill in others sufficient to meet requirements. The search for leadership talent continues incessantly. The balance of the organization must be built out of the only other material available, a superabundance of No. 1 Guys.

ENTER THE PSYCHOLOGIST

Working with their favorite material, Men, psychologists contribute heavily in the solution of snarled industrial problems. They reason that knowledge, in order to be fruitful, must be applied to existing difficulties. Most of the trained psychologists who enter industry maintain a staff functional relationship similar to that of most engineers. They are investigators, analysts, umpires, and advisors, seldom tied to classified production or administrative positions. Their field of general usefulness covers workers, work, and work efficiency throughout the organization. Applying their specialized know-how of handling human material, psychologists improve human relations that have previously thwarted progress of engineering projects.

For instance, in matters affecting the hiring, placing, and retaining of personnel in an organization, psychologists are becoming increasingly active along these lines:

1. Establishment of standards of competence, personality, and emotional stability.

2. Selection and placement of personnel through application of those standards.

3. Institution of merit rating systems to evaluate eligibility for salary increases and promotions.

4. Employee counseling in which employees have the opportunity to unburden their troubles to a sympathetic listener without fear of reprisals to the employee or obligation to expensive corrections for the employer and without unwanted precipitation of baseless complaints into the grievance procedure.

All these functions seek to improve the character, competence, and contentment of workers in their work environment. The techniques are used without fuss or fanfare. Few engineers are aware of the amount or value of excellent psychological-based work carried on around them. The points of contact between engineers and psychologists in these areas remain too few in number.

PSYCHOLOGICAL ENGINEERING

Other investigations of the psychologists, however, come closer to the customary work of engineers. Through application of basic psychological knowledge, the engineer has already been aided in these typical problems:

1. Studies of accident-proneness separate accident-inviting individuals from hazardous jobs and give engineering safety devices a chance to succeed.

2. Understanding the meaning of color permits its use to mark-off passageways, locate fire-fighting equipment, accentuate hazardous structures, and provide a comforting background to employees in repetitive work.

3. Exhaustive studies of vision, particularly of the sharpness of observation, give a basis for selection of superior inspectors.

4. Motion and motion-sequence studies point out a "best" way of performing assembly operations that frequently is far superior to the "natural" way.

5. Training methods based upon educational psychology train employees faster and cheaper.

6. Understanding of the incentives that motivate people and their reactions to orders enables the psychologist to help supervisors do a better job.

All of these activities aim at objectives similar to those sought by engineers, namely, increased production, improved quality, and lower costs. However, the psychologists maintain one significantly different viewpoint. The improvements must be compatible with normal human reactions and cannot be made at the expense of human energy or dignity. Because of this difference, the phychologists can put engineering developments into action with less resistance to acceptance. The engineer stands to gain much more than he now thinks possible by paying attention to the common interests between engineering and psychology. As both groups join forces the effect of No. 1 Guy becomes less conspicuous and 5M prospers accordingly.

BUT WHAT ABOUT TIMMIE?

While all of these trends are developing over the long haul, just where does Timmie stand in relation to what psychologists know? What can be done to make him a more livable person and a better worker? With present day knowledge of vocational guidance, Timmie can learn whether his interests are strong enough and his aptitudes the proper combination for success in engineering work. He can further learn in what type of engineering function he stands the best chance of succeeding.

If 5M used a good pre-employment testing procedure, the company would discover the strong points in Timmie as well as his weak ones. The department head could be advised that Timmie would handle certain types of work very well, other kinds poorly, and that Timmie would need fairly frequent encouragement in order to maintain his self-confidence. Supervisors would not have to remain so puzzled by erratic performance on Timmie's part and they would probably develop more confidence in the man. Even if Timmie doesn't have the stuff to make him a key man in the organization, all parties would benefit by understanding the extent of his capacities.

By altering, within reason, his work assignments, the man could use his best talents and not be forced to use his poorest talents against discouraging conditions. Timmie could be expected to develop a healthier attitude toward supervision and toward his cohorts if he doesn't experience a succession of moral setbacks producing a frustrated mental attitude. With sympathetic listeners available to listen without blackmarking his record, Timmie might even regenerate his self-confidence himself by blowing off steam in the presence of intelligent and understanding equals.

UP TO HIMSELF

Assuming that 5M might help Timmie change his attitude and start back on the road to advancement, Timmie himself must initiate the regeneration. He can give his life a searching inquiry into where he really stands and how it happens that he stands right there. Does he worry too much? Approximately 90 percent of a man's worries are about matters over which he has no control. When Timmie realizes this, he will be able to recover a lot of misspent energy. Does he baby himself into wanting to fail? In order to fail successfully, a person must first overcome the energy naturally spent in wanting to succeed. Once more Timmie can regain energy uselessly dissipated by abandoning futile inclinations.

With a little reading, some discussion with trustworthy confidants, and a lot of downright straight thinking, Timmie will find that by changing his attitude and his behavior, he can encourage favorable changes in the reactions of people around him. He can then recognize that people respond with the same kind of attitude shown them. If he distrusts them, he only invites distrust from them. If he shows a willingness to be friendly, he will quickly learn how hungry his associates have been for a friendly word from him. When he has encouraged a cooperative basis with others, he will realize that he does not begin to have a monopoly on the world's troubles. Then he will find how simply he can help someone else out of a small difficulty, only to experience a reciprocal boost out of a greater vexation of his own. When he controls his temper in an unjust situation, he will be surprised to find out how much improved the admiration of bystanders for him will be simply because of that control. As he starts in to build

"Now get hold of yourself, you."

friendships, he will be astounded by the rapidity with which others will respond warmly and sincerely. He will quickly sense how much better he feels, when he has told his No. 1 Guy to vanish.

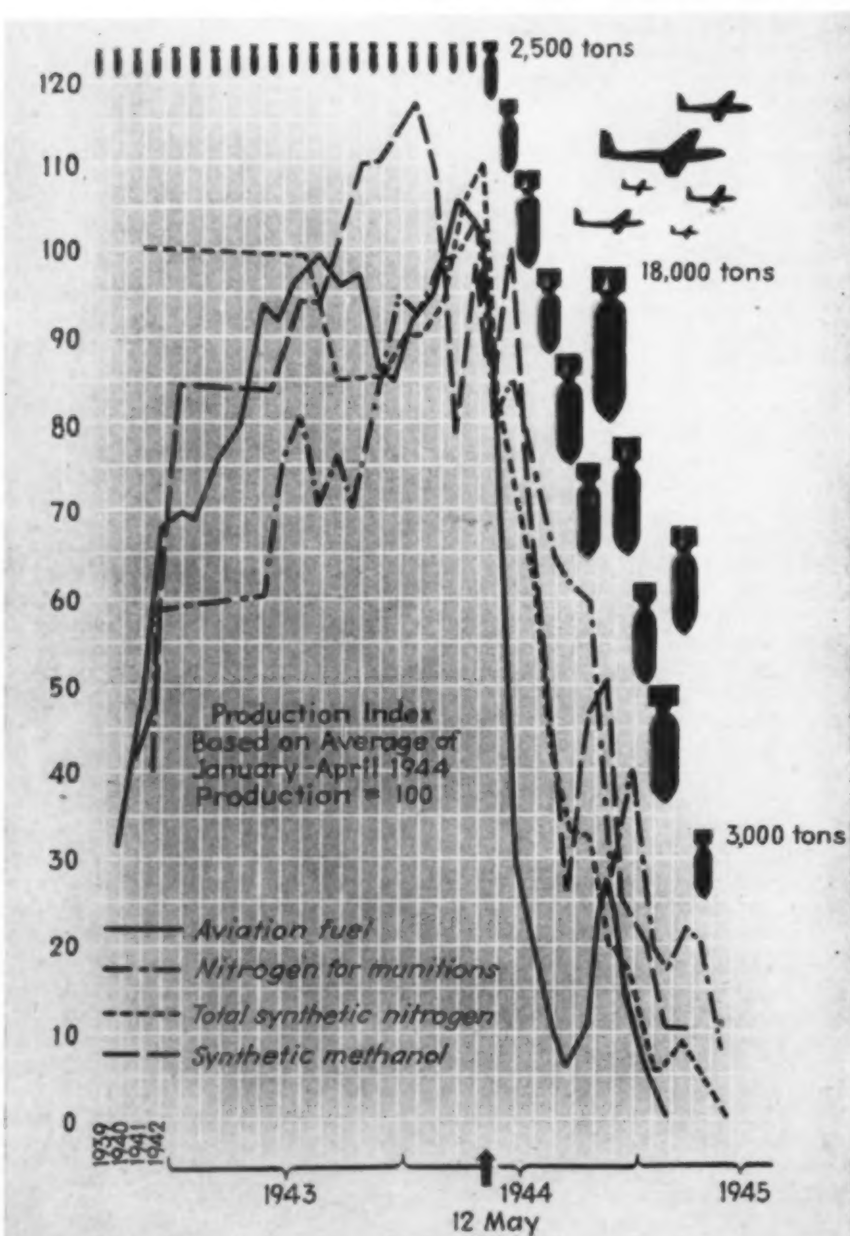
This sounds like a success story. It is one. With an IF. If Timmie hauls himself into a corner and gives himself a good Dutch Uncle talking to. His biggest obstacle at the present time is himself. Even though other factors conspire to hold him back on his road to advancement, the responsibility rests with Timmie to break through or go around those barriers. He may never reach the final goal that he wants, but neither will he be moving anywhere toward it if he does not take hold of his feelings. When he changes his viewpoint, focuses his sights on the advantages of friendliness and cooperation, pitches into his job as though he meant to climb on top of it, then Timmie will gather speed toward his destination.

It can all be boiled down to this. When Timmie ceases to think of doing a job and starts to live up to an opportunity, then he has made himself an interesting person and a man invaluable to 5M.

R. P. RUSSELL and H. D. DALE *Director and Asst. Director, respectively, Oil Division, U. S. Strategic Bombing Survey*

How German Plants Were Knocked Out by STRATEGIC BOMBS

Rise and fall of Germany's chemical process industries



The Oil Division of the U. S. Strategic Bombing Survey investigated results of the air attack on German petroleum, chemical, rubber, explosives and propellants industries. This report which is based on the general summary of the division's final report represents its findings regarding (1) effect of bombing on production, (2) ways in which production was hit, (3) how it could have been hit harder and more quickly, (4) how bombing these industries weakened Germany's war effort. Russell and Hale were associated with a large staff of representatives of oil, chemical and rubber companies, engineering firms and government agencies. — *Editors*

WARTIME Germany was a chemical empire built on coal, air and water. Eighty-four and a half percent of her aviation fuel, 85 percent of her motor gasoline, all but a fraction of 1 percent of her rubber, 100 percent of the concentrated nitric acid, basic component of all military explosives, and 99 percent of her equally important methanol were synthesized from these three fundamental raw materials.

Until the late thirties, most of Germany's liquid fuels were imported—she produced only a third of her 1936 liquid fuel requirements. Then extremely ambitious synthetic oil and war chemicals programs were started. Germany's military and economic planners were so convinced that this program could be completed and maintained without enemy interference that they went to war in 1939 with reserve stocks equal to only.

3.1 months of war needs for aviation gasoline,

1.9 months of war needs for motor gasoline,

1.8 months of war needs for tetraethyl lead,

2 months of war needs for nitrogen satisfactory for explosives, and

2.4 months of war needs for rubber.

Germany never recovered from this precarious position, and throughout the war her oil stocks, particularly critical items like aviation and motor gasolines, were so tight that her whole military effort in the air and on the ground would have collapsed like a pricked balloon in three or four months had her oil supply been dried up.

The oil, chemical, explosives, and rubber industries of Germany were bound together into a vast interlinking complex, so that attacking them was like fighting an octopus. Hydrogen from Leuna was used in making half of Germany's rubber. In the Ludwigshafen-Oppau Chemical Works, the production of oil, chemicals, rubber, and explosives was interdependent. The five synthetic nitrogen plants which produced 84.6 percent of the country's synthetic nitrogen also made the process gas required for the production of 20.6 percent of the synthetic oil. The body of this industrial organism was the gas-generating plants which turned coal into process gases; its arms were the many plants that used those gases and other material drawn from the coal to produce synthetic fuels and lubricants, chemicals, rubber, and explosive products. The largest German chemical plant, at Leuna, consumed 338 million cubic feet of hydrogen-containing process gas a day and 54 million cubic feet of fuel gas, a total of nearly twice the peak wintertime consumption of all New York City. The arms of this gigantic man-made creature could be damaged or severed without killing it, but when the gas plants were hit the whole organism was weakened. When these plants could no longer function, the whole group of industries died.

PRIMARY TARGET: OIL

In the spring of 1944, when the U. S. Strategic Air Forces reached full maturity, the German oil industry was selected as a top priority target group. The first four heavy attacks on oil took place on May 12, 1944, but the heat was really turned on when Gen. Carl A. Spaatz dispatched his memorable cable of June 8 to the Air Forces: "Primary strategic aim of U. S. Strategic Air Forces is now to deny oil to enemy air forces." All oil plants were to be hit with sufficient frequency to insure their being kept out of production.

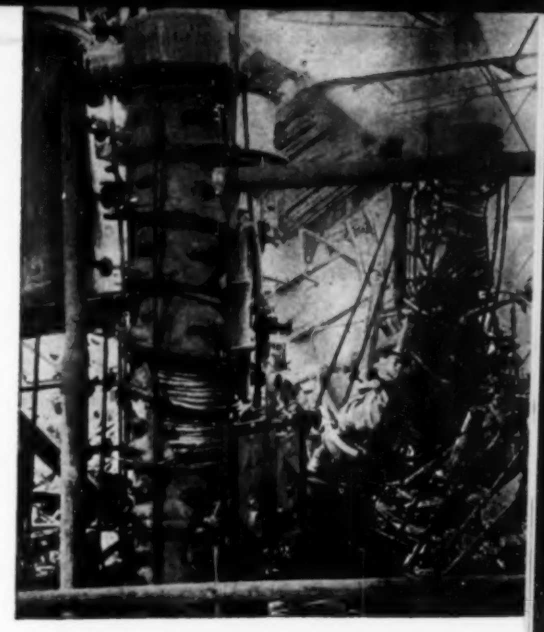
Up to May, 1944, the RAF and USAAF together had dropped 509,206 tons (All bomb tonnages are short tons), and all production tonnages are metric tons, (2,205 lb.,) of bombs on enemy targets in Europe, of which 5,670 tons, or 1.1 percent, went down on German oil targets. None of these attacks caused important loss in German oil production. From May 12, 1944 to May 8, 1945 (V-E Day), the combined air forces dropped 191,256 tons on the 87 German oil-producing targets, and production took the downgrade. The output of aviation gasoline tobogganed. The initial reaction of the Luftwaffe was to offer increased resistance, and consumption increased with a consequent terrific drain on the storage tanks. From August to the end of the war (except December), consumption always exceeded production. Less than 500 tons of aviation gasoline were made during February, 1945, only 40 tons were made in March, none at all in April. Stocks of aviation gasoline on February 1 were only 82,000 tons—barely enough to wet tank bottoms.

With both production and stocks declining rapidly, the most drastic curtailment of aircraft operation was put into effect. Training was eliminated in September, and essentially all operations except combat flying were prohibited. In the closing months of the war, Luftwaffe pilots were sent into combat with only 40 to 45 hours of flight training—sitting ducks for our well-trained air crews. Germany's large reserve of military aircraft stayed on the ground with empty tanks, unable to oppose the advancing forces. The situation with regard to motor gasoline was no less disastrous. Tanks and armored vehicles were moved to the front by oxen. Every motor trip exceeding 60 miles had to be approved by a commanding general. A speed limit of 17 miles per hour was imposed.

Among Germany's key war chemicals were synthetic nitrogen, methanol, tetraethyl lead, and rubber. Without nitrogen, not a single ton of military explosives or propellants could have been made, and there would have been no fuel for some of the rocket devices. Certain military explosives were entirely dependent on synthetic methanol. Without tetraethyl lead, the octane number of the Luftwaffe's aviation gasoline would have been so low that a 2,000-hp. fighter engine would have been able to deliver only 1,200-hp. in the pinches—inadequate against Allied planes. Without rubber, the war machine could not have rolled.

Germany's synthetic nitrogen and synthetic methanol plants were few in number, though of large capacity, but an ambitious expansion program was undertaken just as war broke out. With this program in view, the war planners were apparently not too uneasy about the minute stock piles in September, 1939.

Tetraethyl lead, with all production prior to 1939 centered in one plant, was too scarce and concentrated for comfort. A second plant was built, coming into operation in July, 1939, a French plant was captured, and a third German unit was scheduled for completion in 1945. An underground plant was also planned, but no equipment was ever installed. The stock pile of tetraethyl lead in September, 1939, was equal to just 1.8 months of war requirements. Ethylene dibromide, a vital ingredient for ethyl fluid, was manufactured in only one plant.



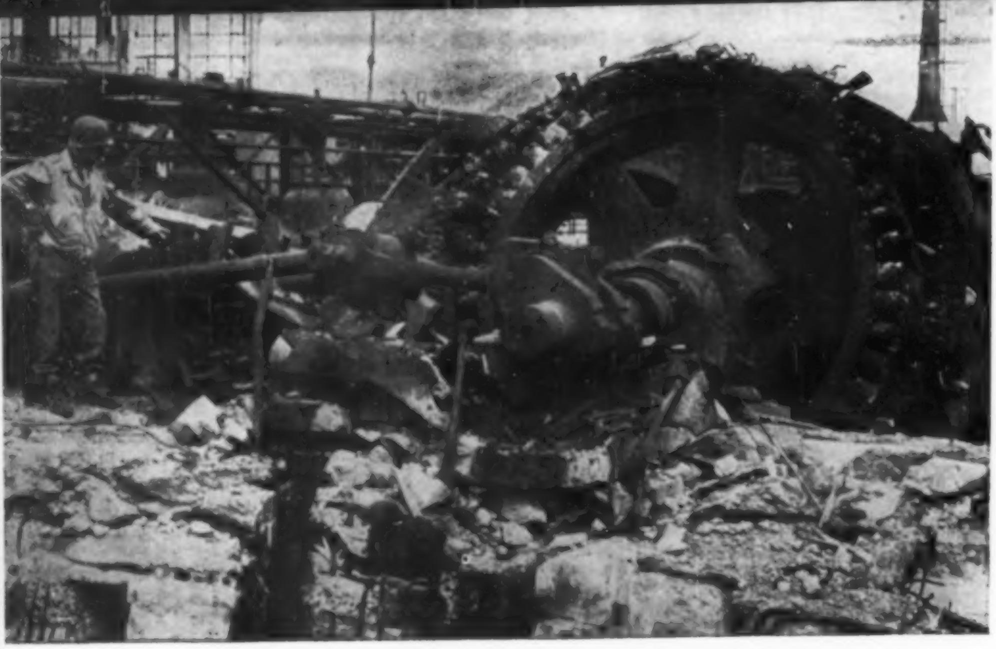
Hydrogen peroxide columns show effectiveness of 500-lb. HE bombs on lightly constructed chemical plants

Rubber for the war machine was also critically scarce, but the development and fabrication of synthetic rubber had advanced successfully by 1936 and 1937. The first large synthetic plant (at Schkopau) was in operation well before the war, and a second large plant at Huels came into production in August, 1940, while a third plant at Ludwigshafen opened in March, 1943. The rubber stock pile in September, 1939, was equal to 2.4 months of requirements.

The planned expansion in the military explosives and propellants industries began secretly in 1934. Many plants were built, and the expansion and dispersal plans were well worked out, except that the military were always reluctant to approve adequate facilities for their basic raw materials, apparently finding it difficult to understand that without such raw materials their many overcapacity powder and propellants plants could not run.

AIR ATTACKS

Neither the German chemical industry nor any vital segment of it was selected by the Allied air forces for deliberate concentrated attack. As far as Oil Division personnel could ascertain, no single attack was dispatched against synthetic nitrogen and methanol, despite the readily perceptible military consequences. Yet both of these vital chemicals were knocked out as a bonus—fortuitous perhaps and until the end of the war unrecognized—resulting from the vigorous campaign against oil. When two plants (Leuna and Ludwigshafen) were shut down by air attacks dispatched against oil targets, Germany was deprived of 63 percent of her synthetic nitrogen, 40 percent of her synthetic methanol, and 65 percent of



Eleven direct hits by HE bombs destroyed all seven compressors

her synthetic rubber. Damage to five additional oil plants increased the loss in synthetic nitrogen to 91 percent, in synthetic methanol to 86 percent. When the nitrogen supply beagn to vanish, agriculture was the first to feel the pinch. No synthetic nitrogen was available for fertilizer after September, 1944, and the anticipated drop in the 1945 harvest from this cause alone was estimated at 22 percent.

From September on, the Wehrmacht felt the blow, and in spite of frantic attempts to install plants for converting byproduct coke-oven nitrogen into a form satisfactory for explosives manufacture, stocks of explosives had dropped by January, 1945, to less than two months' requirements. High explosives were only 33 percent and ammonium nitrate 12 percent of peak production. Thousands of finished shell cases remained unfilled, and those that were filled contained up to 70 percent of rock salt to stretch the small supply of explosives. The reduction in munitions effectiveness was about equal to the percentage of rock salt used. Supplies of anti-aircraft ammunition were so short, according to Gen. von Axthelm of the Flak Artillery, that battery commanders were ordered not to fire at enemy aircraft overhead unless (a) the airplanes were attacking the target which the battery was supposed to protect, (b) the commander was sure he could hit the airplanes!

That nitrogen plants were given a higher repair priority than oil plants is easy to understand. Why Allied military intelligence —at least as far as Oil Division personnel could learn—failed to pick up knowledge of the situation until the plants were available for inspection is less comprehensible.

There were 35 large explosives and propellants plants, seven of which made 70 percent of the total production of high explosives. These plants were never selected for serious strategic attack, although it may be argued that knocking out these key plants might have curtailed production of explosives with less expenditure of effort than the incidental knockout of synthetic nitrogen plants. As the result of a single raid by two Halifaxes which dropped two 2,000-lb. bombs and 1,748 incendiaries, half of the TNT production capacity of one of these plants was destroyed and never recovered.

HOW KNOCKED OUT

There are two principal ways of stopping production of heavy process industries such as the German oil-chemical complex: They can be knocked out permanently by a heart blow, or they can be temporarily incapacitated by non-fatal injuries. The heart of any plant in such a complex is its supply of basic process material. In the German oil-chemical industry this was process gas. Cutting off the gas supply, through knocking out the conversion plants, the gas purification plants, or the compressors which compressed the gas, would have dealt a heart blow to the complex. The veins, arteries, and nervous system are the water, steam, and electric distribution systems. These are so spread out that total destruction is practically impossible (unless a steam-generating plant, an electric generating plant, or a water plant is destroyed, which was never accomplished in German oil-chemical plants), but they can be damaged, and production is impossible until repairs are made.

What kept Leuna and some of the other German oil-chemical plants shut down was damage to water lines, gas mains, sewers, and electric cables. After the first two attacks on Leuna, 94 percent of the utilities damaged had to be repaired before the plant could be reopened, although only 8 percent of the building damage had to be repaired. By November, 1944, there had been over 1,500 breaks in the water system alone, each of which, according to the plant manager, "would have been considered in peacetime a serious disturbance to production." The 22 attacks on this plant resulted in more than 5,000 individual breaks in the utilities distributing systems. But by achieving some production between attacks, the plant managed to average about 9 percent of normal output throughout the period.

Vital process installations were so effectively protected by blast walls and reinforced concrete "dog houses" that essential, hard-to-replace equipment was seldom destroyed by the munitions generally employed. In a few instances, of which the Bottrop-Welheim (Ruhroel) hydrogenation plant is the most striking example, this destruction was accomplished. In two raids, September 27 and October 31, 1944, the RAF hit the high-pressure compressor house with three 4,000-lb. and eight 1,000-lb. bombs. The seven heavy compressors and boosters, through which was funneled every cubic foot of the hydrogen required for the process, were completely destroyed. The plant could not operate until new compressors were installed. This meant a 12-month shutdown if new compressors had to be built and a delay of three months if replacements could be "lifted" from another plant. The four subsequent attacks on this plant were unnecessary. These results may be compared with those at Leuna, which, after being hit by 1,643 tons of bombs in 22 attacks, could have reached 70 percent of normal production capacity within a few months without the importation of any new heavy equipment.

Knocking out vital utilities might be termed "the hard way" to stop war production since the bomb dosage must be repeated so often. Destroying vital process equipment means that the plant need not be attacked again for months.

TREMENDOUS AIR EFFORT

Under the conditions created in Germany by heavy flak, fighter opposition, bad weather, and effective smoke screening, it was necessary in a high percentage of the attacks to use instrument bombing, which proved to be far less accurate than visual bombing. As a result, tremendous bombing tonnages had to be flown from England in order to hit vital parts of plants with a relatively small tonnage. Detailed records for three plants (Leuna, Ludwigshafen-Oppau, Zeitz) show that, of 30,000 tons of bombs dropped, only 3,781 tons hit within the plant fences. Different aiming techniques gave the following results:

Air Force and Technique	Percentage of Hits Within the Plants
Eighth Air Force, visual aiming	26.8
Eighth Air Force, part visual and part instrument	12.4
Eighth Air Force, full instrument	5.4
RAF, night Pathfinder technique	15.8
Weighted average	12.6

What happened to 146,000 bombs re-

leased by the USAAF and the RAF in the strategic bombing of these three large German oil-chemical plants? Their combined area is about 3.5 square miles; yet only 12.9 percent of the bombs dropped landed within the plant fence limits. Hitting within the plant fences does not tell the whole story. Some bombs failed to explode (carefully kept German plant records indicate that 14.1 percent of all of the bombs hitting these plant areas failed to explode), some fell in open areas where no damage was caused, some hit unessential buildings, some fell on the utilities distribution systems, and some hit vital plant equipment. Only about 3 percent of all the bombs dropped hit buildings, equipment and other damageable structures. It is thus clear that the greatest single chance for bombing improvement in air attacks lies in even a small increase in bombing accuracy.

WASTED MISSIONS

Unexploded bombs bespeak wasted missions and lives of fliers risked in vain. In two plants surveyed, unexploded bombs amounted to 24 and 31 percent of those landing within the fence lines. The average for 13 plants was 1 percent. A study of unexploded bombs found throughout Germany indicated that frequently the bombs had landed flat because the tail fins had become detached or had broken off during descent; other bombs still had the arming wires intact in their fuzes when they were found; in others the fuzes had broken off. Seven 500-lb. bombs dropped in a single raid struck the reactor house of the Fischer-Tropsch plant at Castrop-Rauxel, a sufficient number to have demolished it completely. None of them detonated, and the reactor house was intact on V-E Day.

Prior to the oil offensive, 53 percent of the 509,200 tons of bombs dropped on Germany were aimed at cities and only 13 percent at industry, including only 1.1 percent assigned to oil targets. During the oil offensive, 27.5 percent of the 1,477,217 tons dropped were aimed at cities, and 22 percent at industries, including 15.9 percent assigned to oil targets. Why so many tons of bombs were dropped on cities in preference to the more vital industrial targets is not known to the Oil Division. No doubt exists, however, regarding the benefits to humanity that would have resulted from an earlier knockout of these essential industries.

Detailed plant examinations convinced Oil Division engineers that, in spite of the bombing inaccuracies involved, a vulnerable plant section chosen consistently as an aiming point could be destroyed. An outstanding example was the high-pressure research area at Ludwigshafen, which, although it contributed practically nothing to the war production, was chosen as the aiming point in 10 out of 25 attacks on the Ludwigshafen works. It was completely destroyed. At Leuna, although the gas generation plant was known to be vulnerable and the most vital part of the entire plant, it and its vicinity were designated only 16 times out of 48 specific aiming points. In other words, only about one-third of the airplanes attacking Leuna aimed their bombs at the most vital and vulnerable parts of the entire target.

The small bombs generally used against German oil-chemical targets were capable of creating breaks in vital utilities systems, thereby temporarily shutting off plant production, but only very rarely were small bombs able to destroy vital equipment. (During the oil offensive, the average size of all the 508,512 high-explosive bombs dropped on oil producing targets by the USAAF was 388 lb., and of the 263,942 dropped by the RAF, 660 lb. The average for both air forces was 480 lb.) Winning a war with small bombs requires a tremendous air force, but this is possibly the only choice open if visual sighting is not possible or if vital aiming points are not chosen.

Few large bombs were used against German oil-chemical plants, and most of these were dropped by the RAF. It is the unanimous conviction of all Oil Division observers that, under bombing conditions which permit sighting on a specific aiming point and with reasonable bombing accuracy, heavy bombs (2,000 to 4,000 lb., instantaneously fuzed) are several times as effective per ton as the lightweight bombs (500 lb. or less) used principally against German oil targets.

INCENDIARIES NOT EFFECTIVE

Very few instances of appreciable production loss were caused by the small number of incendiaries used against German oil producing targets (only 6,541 tons out of a total of 196,052 tons). In most instances, incendiaries burned themselves out or were extinguished before spilled oil or other flammable material had time to spread and become the focal point of a serious fire. It was the opinion of German plant managers, concurred in by all Oil Division observers, that incendiaries dropped after or set to ignite several minutes following high-explosive attacks, would have resulted in far more serious fire damage.

The short duration of most USAAF raids enabled German defense personnel to leave shelter in time to deal with incendiaries and incipient fires before conflagrations were started. Because of the longer duration and lack of uniformity of RAF raids—each bombardier sighted his bombs independently, whereas the customary practice in the Eighth Air Force was for pilots to release their bombs on a signal from the lead plane —RAF attacks were, by almost unanimous agreement among the Germans interrogated, more terrifying and more damaging. Had it been found possible, within the limitations imposed by operational considerations, to vary the length and pattern of USAAF raids, greater results would have been achieved for the same expenditure of bombs.

CONCLUSIONS

The Allied air offensive against the German oil-producing target systems:

(a) Effectively stopped oil production with decisive military consequences;

(b) As an unexpected bonus, effectively stopped production of military explosives and propellants, thereby contributing an additional decisive effect;

(c) Could have been accomplished with less effort if bombing accuracy had been better, if aiming points had been more wisely chosen, if munitions capable of destroying vital process equipment had been employed whenever reasonable bombing accuracy was obtainable, and if sounder military intelligence had been made available;

(d) Indicated that none of the German protective measures, even after major improvements, would fully protect American industry against enemy air attack.

High degree of destruction by HE bombs at Elektrochemische Werke Muenchen. Only peroxide building remained intact. 70 bombs hit buildings

EDMOND C. FETTER *Assistant Editor, Chemical and Metallurgical Engineering*

DORON ARMOR

An Achievement and a Promise in Plastics

By laminating glass cloth with a contact resin, there was produced during the war a light armor known as "doron" which surpassed any metallic armor in ballistic efficiency. The research and development program behind that achievement provided for the glass manufacturer, the plastic fabricator, and the resin manufacturer, an opportunity to explore a material that may well continue to compete with metals in peacetime application.—*Editors*

If ever a new product started from scratch, it was doron. Before 1942 plastic armor had scarcely been heard or even thought of. Moreover, ballistic experts proclaimed almost unanimously that the idea was impractical and that metals—Hadfield manganese helmet steel or perhaps aluminum—were the only materials which had the properties fundamental to light armor. Doron in 1942 was inspired by the lone fact that there was not enough metallic armor to meet requirements.

Today doron is a standard item and hundreds of tons have been used as light body armor in the Navy's kapok life jackets. It is markedly superior to either Hadfield steel or aluminum. Doron's specific war job was to guard a man's chest, abdomen and back against shrapnel from light caliber fragmentation shells; it furnishes protection of the same order as a helmet though it is actually better than helmet steel on a weight basis.

Aside from saving lives and opening new fields for armor research, doron has made important contributions in other fields. Resin manufacturers have gained valuable experience in manipulating their relatively new contact resins. Laminators have developed techniques for fabricating the toughest material they are ever likely to encounter. And the groundwork has been laid for a variety of new products built around doron's two components, glass cloth and contact resins, combined either with each other or with different materials.

WHAT IS IT?

Wartime specifications for doron were concerned chiefly with four points: It was to be made of Owens-Corning Fiberglas cloth ECC-165; bonded with an "approved" resin; manufactured by a "qualified" laminator; and it was to suffer no more than a certain maximum number of penetrations in the Dahlgren (Naval Proving Grounds, Dahlgren, Va.) forward spray ballistic test, the exact number to depend upon the weight of the panel. As the last requirement implies, doron can be made in any weight, and it has been made experimentally all the way up to 15 lb. per sq.ft. However, the only doron produced in important commercial quantities weighed 1.3 lb. per sq.ft. and therefore, in common parlance, doron has come to mean this particular material.

Tonnage-wise, practically all the doron made is accounted for in the 300,000 sets of inserts used by the Navy Bureau of Ships in the life jackets worn by Naval personnel and transients aboard ship, particularly landing craft. In addition to that amount, a few thousand sets were used by submarine personnel and by the Marines. Doron is a stiff, thermoset panel about ⅛ in. thick, made up of 15-18 cross laminated plies and containing 23-25 percent resin. It costs $3 to $4 per lb. or about $17 per life-jacket set. Because low-resin content is required to get good ballistic properties, doron's ordinary mechanical properties such as flexural and edge compressive strength, are low.

As armor, doron was designed to keep a man from being killed by the spray of fragments* from a medium velocity, high explosive shell, motor, or grenade—provided he was far enough away to survive the concussion blast. Doron will also stop a 45-cal. tommy-gun or pistol bullet point blank, but that is a very minor consideration, since these weapons account for relatively few casualties in modern war. However, estimates place the number of fragmentation casualties at two-thirds of the total for all weapons, with a large proportion of these coming from the light shells against which doron is specific. Doron will not stop a rifle or machine-gun bullet or the heavy fragments from large shells; protection of that sort requires armor weighing upward of 10 lb. per sq.ft. and is completely outside the body armor class.

* These fragments look much like splintered razor blades.

NEEDLE IN A HAYSTACK

The development of doron divides chronologically into four periods, first, the groping for a material that would at least show some promise, then concentrating on that material to develop its ultimate flak resistance, subsequently getting the final version into commercial production, and finally, estimating where doron may go in the future.

The groping period began in 1942 when the Quartermaster Corps was unable to get Hadfield steel, the traditional helmet material, for Civilian Defense helmets. In June of that year, Brig. Gen. Georges F. Doriot, Chief of QMC's Military Planning Division and from whose name "doron" was coined, instructed his Plastics Section to investigate plastics as light armor. QMC was soon joined by Naval Research Laboratories, which had for about a year been working with nylon as light armor material. According to the division of labor agreed upon, QMC was to handle the preparation of plastic materials, while NRL handled the ballistic studies and evaluations including the development of test methods.

Hoping that there might be certain general principles which would lead logically to a suitable plastic, QMC sought the counsel of those experienced in armor and ordnance. However, instead of a hope-inspiring clue, QMC found that all ballistic theory and experience pointed to high strength and ductility as the two indispensables of light armor, and no known plastic had that magic combination. Therefore,

since no approach was reasonable, QMC had no choice but to try everything conceivable. And that meant hundreds of tests on all kinds of plastics.

However, experience with laminates of nylon cloth and film developed the idea that delamination (if doron should prove to be a laminated material) was essential to good ballistic performance. And in May 1943 the Dow Chemical Co., which had been preparing samples for QMC, laminated some odds and ends of glass cloth with ethyl cellulose in such a way as to obtain this poor bonding or delaminating effect. That panel was the first true doron and is now, literally, a museum piece.

HOT SCENT

It was now obvious that doron was on the right track, and QMC was authorized to intensify its research program. Aided by the Committee on Quartermaster Problems of the National Research Counsel, QMC enlisted the cooperation of a number of industrial concerns* to whom it assigned various phases of the over-all problem, i.e., the systematic study of all factors which might effect the ballistic qualities of a resin-bonded glass-cloth laminate.

As one part of the work, General Electric's E. L. Thearle evolved a ballistic theory to explain how and why doron stops a projectile. This analysis attributes stopping power to high-strength filaments and low-strength binders—the latter because it permits the fibers to break loose from each other and distribute stresses by slipping over one another, much as ductility in metals permits stress distribution by plastic flow. The ability to delaminate is thus the crux of doron's ballistic performance, and the explanation for its low resin content and poor mechanical properties. In their respective roles, glass is the energy absorber, while the resin acts essentially as a jig, holding the filaments in position to engage the projectile and not merely be brushed aside by it.

Doron's physical properties got wide attention from almost all investigators. However, it was never possible to establish any consistent and clear-cut correlation between statically determined properties and ballistic performance, and consequently the research program would have to proceed on the basis of ballistic tests. NRL had been working on such tests and was ready with one, the so-called yawed dart test, which seemed to be a reliable indicator of flak resistance and was, moreover, a practical procedure for laboratory control work. The "dart" in this test is a small piece of simulated flak which is fired from a smooth bore carbine; "yawed" means that it is caused to tumble in flight so that, flak-like, it strikes the test panel flat-wise. Later the Dahlgren forward spray test was set up as the final word on doron's acceptability, since, though less convenient, it is a more obvious measure of flak resistance than is the yawed dart test. In the Dahlgren test a 20-mm. high explosive shell is fired at a thin steel detonating plate with the test panel a few feet behind it. Shell fragments spray against the panel and the number which penetrate is the criterion for acceptance.

Numerous fabrics of special weave were supplied by Owens-Corning for evaluation in doron. The one finally chosen is characterized by high-strength filaments, almost unidirectional orientation of the fibers, and the use of glass fibers as fill. Square weave fabrics were eliminated because it was thought that the zig-zag course of its fibers would reduce their effective tensile strength, and cotton fill yarns gave way to glass to avoid shrinkage upon impregnation.

To make progress in development it was necessary to concentrate early on some suitable type resin. Dow and Hercules pushed work on ethyl cellulose, while American Cyanamid, Bakelite, Monsanto, and others evaluated other possible binders. As pointed out above, the binder is relatively unimportant in determining ballistic performance. This made it possible to choose a resin primarily for its convenience in manufacturing operations and, significantly, all three of the last-named companies chose the thermosetting contact resin, polyester-styrene copolymer, as combining the greatest number of processing advantages with satisfactory ballistic properties.

Investigation of both ethyl cellulose and the contact resin brought a great many variables under consideration. Among the most important things to be determined were the following: Optimum resin content to balance ballistic and structural requirements, the correct viscosity to get the desired resin pick-up during coating, the most efficient time-temperature-pressure curing cycle, a method for incorporating mold-growth inhibitors and color without impairing other properties, and finally the effect of water absorption and the feasibility of applying water-repellent sizing to the cloth.

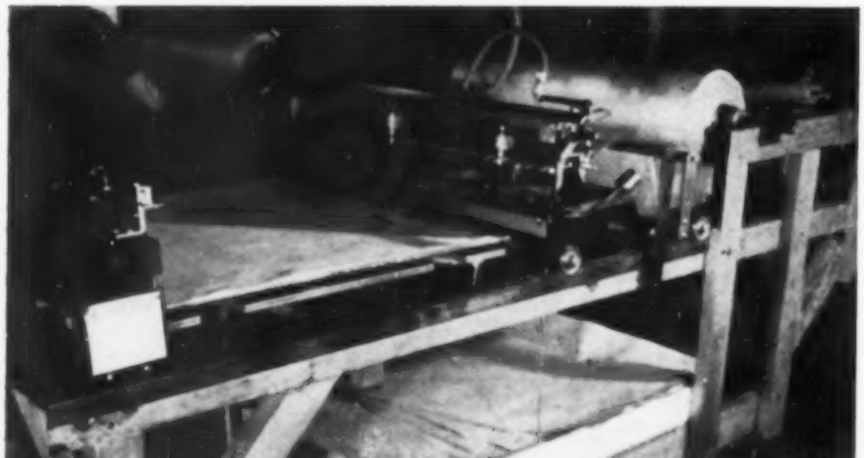
FOUND AND FABRICATED

By the fall of 1944 it was thought that doron's complexities were sufficiently well understood to justify commercial production and the Navy Bureau of Ships requisitioned 300,000 life-jacket sets. Part of these were to use ethyl cellulose as binder and the rest, contact resins. However, doron made with ethyl cellulose subsequently proved to make a poor showing after cycling (alternate exposure to humid heat and subzero cold) so the whole contract was changed to contact resin.

The first laminators to accept doron contracts did so in spite of strong misgivings. With its low resin content the material would obviously be difficult to fabricate without causing delamination. Moreover, manufacturers knew almost nothing about

Doron's only big war use was as body armor inserts for Navy's kapok life jackets. Set weighs about 5 lb. and consists of eight panels which button into pockets, outlines of which can be seen here. Panels can be jettisoned quickly if necessary

* At the start of the program these concerns were: American Cyanamid Co., Bakelite Corp., National Bureau of Standards, Dow Chemical Co., General Electric Co., Goodyear Tire and Rubber Co., Hercules Powder Co., A. D. Little, Inc., Monsanto Chemical Co., Owens-Corning Fiberglas Corp., Plaskon Div. of Libby-Owens-Ford Glass Co., and Rensselaer Polytechnic Inst. Later, some of these dropped out and many others were enlisted.



One manufacturer employed this special machine to build up doron laminate. Impregnated cloth from roll is drawn forward, cut, and dropped onto build-up table, which can be rotated for cross-laminating. In all, five laminators participated in the project and in one year produced about 700 tons of armor

production methods for this type material; they had to work to an intangible requirement in the completely unfamiliar field of ballistics; and there was no time for anything approaching an adequate pilot plant study. Worst of all, doron was to be tested for acceptance in 8,000-lb. lots and there was no reliable plant control test—some $30,000 worth of it thus had to be made "blind."

However, a number of manufacturers did volunteer and "qualified" for contracts by demonstrating their ability to produce 1.3-lb. doron which would pass the Dahlgren test before and after cycling. Since they were permitted considerable freedom in the production methods they used to qualify, the processes adopted by the several laminators, though identical in basic scheme, varied considerably in detail.

PRODUCTION METHODS

In the coating operation all manufacturers used a reverse-roll coater, in which the two calendar rolls turn in opposite directions and the amount of resin transfer is controlled by the distance between rolls. Depending upon the laminator, the top roll and the cloth may move in the same or opposite directions. Roll coating, as compared to other coating methods, was particularly well suited to doron because it permitted uniform and controllable transfer of a small amount of resin without the use of fabric-crushing squeeze rolls. In commercial production it proves simple and effective.

After the cloth was coated, it was rewound and the reel incased in cellophane to facilitate handling and to reduce volatilization of styrene. If kept cool and out of direct sunlight, contact resins polymerize slowly, in general permitting an assembly time of several days; however, in the case of doron it was found important that reels of wet cloth be allowed to stand no longer than overnight before building up the laminate and curing.

In the build-up operation, which gave considerably more trouble than the coating operation, it was necessary to measure out 36-in. lengths of coated cloth, cut it, and lay up 15-18 sheets of this slippery, sleazy fabric in a neat square pile, being careful that every other ply was turned at right angles. Most fabricators accomplished this in rather elementary fashion. The reel of wet cloth was mounted horizontally, the cloth drawn by hand across a table, cut to a mark by a guillotine, and laid up by hand on a square table with a few nails around the edges much like a curtain stretcher. This build-up table was made revolvable for easier cross-laminating. One laminator got more speed and uniformity with less manual handling simply by mounting his turntable at the end of the draw-out table and slightly below it; this permitted him to draw the cloth directly over the turntable, cut it, and drop it straight down onto the build-up. Another laminator measured his cloth by unreeling it onto a cylinder whose circumference was 36 or 38 in. After rolling up several layers, all were cut at once and the individual plies peeled off and laid up by hand. As a final variation and by far the most elaborate, one laminator mounted two reels of wet cloth at right angles to each other and in such a way that they could be rolled back and forth across a non-revolving build-up table. The reels were mounted on tracks running above the table, and by unreeling fabric from first one, then the other, alternate plies were cross-laminated. It was not necessary to peg the cloth on nails, nor to cut it until the build-up was complete.

Curing the built-up laminate offered no special difficulty once the curing cycle had been established. Cellophane sheets were placed at the top and bottom of each laminate to avoid sticking, to get a smooth finish, and to minimize the evaporation of styrene. Temperature and pressure varied from one laminator to another, but good doron was produced at platen temperatures within the range 200 to 285 deg. F. and pressures of 175 to 300 psi. All laminators used multiple opening presses; some cooled the platens before removing the cured laminates and some did not. A complete curing cycle, including loading and unloading the press, fell somewhere between 20 and 30 min.

The final operation, fabrication, was by far the most difficult part of the process. Fabricating consisted of cutting the cured 36x36-in. laminates into the simple shapes required to fit a life jacket. However, doron is exteremely difficult to cut without delaminating the edges. For the sake of speed, economy, and ease in holding tolerances, most laminators tried to die-cut the panels, but dies were dulled after a very few cuts and a great amount of work went into improvement of die design. Delamination was extremely serious but could be minimized, it was found, by trimming off only a little doron at each cut and using a series of dies diminishing in size down to the final dimensions of the desired panel. Most laminators cut at room temperature, but one felt the operation was easier if the panel was still hot from the press.

Only one laminator did not employ die-cutting and he used either a saw or abrasive disk to cut straight lines and produced rounded corners by grinding. The only successful saw was a metal disk, at first copper and later steel, with diamond chips embedded in the periphery; water was the coolant. Five or six panels could be clamped, sawed, and ground at one time. Later the edges of each panel were buffed smooth. Saw cutting caused no delamination but it was slightly more expensive than die-cutting and somewhat harder to hold tolerances.

NOW WHAT?

Though doron itself may pass from the public gaze, its descendants will make a strong bid for recognition. Unfortunately, no proved peacetime applications can be set forth for this type material because it was developed entirely within the war period to meet war requirements. However, its properties have been well established, and glass cloth, laminated with 40-60 percent contact resin (double doron's resin content) has the appearance of a unique and valuable tool for plastic engineers.

One outstanding characteristic of the laminate is its great strength. Tensile values as high as 45,000 psi. for cross-laminates and 100,000 psi. for unidirectional laminates surpass any previous plastic, and the latter compares favorably with the tensile strength of aluminum and carbon steel. Having a low specific gravity, around 1.75, the laminate's advantage on a strength-weight basis is even more pronounced. More-

Characteristics of Fiberglas Cloth ECC-165

Weave	Crowfoot satin
Weight, oz. per sq. yd.	8.7
Width within selvages, in.	38 and 40
Warp yarn	450-4/3*
Fill yarn	450-1/0
Warp yarns per in.	50
Fill yarns per in.	30
Warp strength of cloth, lb. per in. of width	700
Fill strength of cloth, lb. per in. of length	25
Filament dia., in.	0.00020–0.00025
Filament tensile strength, approx. psi	300,000

* This signifies three-ply yarn, each ply containing four strands, and each strand "weighing" 450 hundreds of yd. per lb. Each strand contains 204 filaments, or a total of 2,448 filaments in each warp yarn. Fill yarn, being but a single strand, contains only 204 filaments.

over, this advantage is held, in greater or less degree, throughout the other structural properties—compression, flexural, and impact strength. Modulus of elasticity is not high, about 2x10^6 psi., but it can be controlled over a wide range as a function of the amount, weave and orientation of the glass cloth. Preferred orientation of the cloth also makes directional properties possible if they are desirable. Although extraordinary strength values are not obtained with fillers other than glass cloth, it is possible to produce hard, rigid objects using contact resins in conjunction with cotton duck, rayon, nylon, and related types of cloth or paper.

Just as important as their strength, is the ease with which the laminates can be molded. Because no volatiles are given off during polymerization there is no necessity for high laminating pressure and no necessity for heavy presses and strong steel dies. Layers of impregnated cloth are merely draped over or into a cheap wood or plaster mold of any desired shape, held under just enough pressure to keep the laminates in contact with each other and the mold, and baked at about 220 deg. F. for 10-30 min. Thus, compound curves and large sized articles are clearly an important part of the material's future. Designers look forward to such products as refrigerator cabinets, boat hulls, inexpensive wall panels made by continuous coating and curing, automobile fenders, tables and other furniture, truck bodies, luggage, and aircraft components. In general, the best field appears to be among products where design changes are frequent and production is in thousands rather than millions; here the saving on costly metal dies will have real significance.

Aside from structural strength and ease of molding, there are other properties which will be valuable in certain applications. Water absorption and thermal expansion are quite low and dimensional stability is correspondingly good. The resin is a nonconductor of electricity and its insulating qualities are particularly good at high frequencies. Chemical resistance is sufficient to permit production of containers for water and gasoline as well as underground oil and gas pipe. Though machining qualities of high-resin laminates are not nearly as bad as were doron's, machinability is still no selling point. However, ordinary machine shop equipment can be made to do a satisfactory job where the need for machining cannot be eliminated, as it very frequently can be by capitalizing on the unusual adaptability of the molding process. Other characteristics that have received favorable comment are: weather and rot resistance, wet strength, absence of taste or odor, temperature resistance sufficient for service at 275 deg. F., and unlimited possibilities for color and surface effect.

In short then, one may think of contact-molded glass laminates as a "metal" which doesn't corrode, won't conduct heat or electricity, has a controllable modulus, is perfectly elastic, and above all can be shaped easily without costly dies and presses. The many agencies in the chemical industry who participated in the development of methods and materials for this type laminate have about come to the limits of their field; the next move is up to the engineers in the plastics industry who are responsible for the design of consumer products.

Contact Resins Used to Laminate Doron

Laminac 4122	American Cyanamid Co.
Thalids X-526 and X-526S	Monsanto Chemical Co.
Bakelite XRS-75	Bakelite Corp.
Selectron 5003	Pittsburgh Plate Glass Co.

All resins are thermosetting polyester-styrene copolymers.

Wartime Progress in Alumina and Aluminum

United States ended the war with aluminum capacity twice the total world consumption of 1939. The lowered price of aluminum ingot, now 25 percent below prewar levels, and the fact that many thousands of additional workers are familiar with the characteristics and advantages of the metal and its alloys through its widespread use in the manufacture of war materials give promise of market expansion.

Disposal of the government-owned surplus alumina and reduction plants was speeded up recently when the Aluminum Co. of America granted royalty-free licenses to the Reconstruction Finance Corp. for the Alcoa patents relating to the extraction of alumina from low-grade bauxite for use in the Hurricane Creek, Ark., plant then about to be leased to Reynolds Metals Co. The Hurricane Creek plant has an annual capacity of 1,555,000,000 lb. of alumina, sufficient to smelt 800,000,000 lb. of aluminum. The operation of this plant would assure the availability of quantities of low-cost alumina adequate for the smelting of metal not only at the government-owned aluminum smelting plant at Jones Mills, Ark., which was also being leased to the Reynolds Metals Co., but also to any or all of the three government plants in the Pacific Northwest, as well as to other smelters.

The patents involved cover: (1) The use of the lime soda-sinter process in combination with the Bayer process, (2) continuous digestion, and (3) use of starch as a settling and filtering aid.

Early in the war it was recognized that information on processes for obtaining alumina from materials other than high grade bauxite might be badly needed if the German submarine campaign in the Caribbean continued much longer. Four government-financed demonstration plants were built to develop and prove processes for obtaining alumina from low-grade materials.

In an effort to use lower-grade bauxites, as well as clays, the Aluminum Co. of America proposed a lime-soda sintering process on the basis of small-scale pilot plant tests. The proposal was accepted and the process was put into use at four Defense Plant Corp. sintering plants that were built at the four alumina refineries operated by the Aluminum Ore Co. (Alcoa subsidiary).

Where the Bayer process alone would recover not over 70-85 percent of the alumina in the bauxite, depending upon the grade of bauxite used, the combination process recovers up to about 95 percent, even with lower grade ores. In addition, the combination process recovers 60-65 percent of the soda charged to the Bayer process. Thus materially decreasing lime and soda ash requirements.

Not all developments in aluminum have had to do with the process, since many concerned new alloys, finishes and applications. The past year marked the commercial introduction of new clad alloys which combine high yield strength with good resistance to corrosion. Alcoa's new high strength 75S alloy and Reynolds R303 alloy, both newcomers, have found wide acceptance; they are the strongest aluminum alloys of their type ever used. Alloy 63S, which made its debut during the war, is noted for its ability to take a bright, clean anodic coating. Significant progress was made during the last year in the fields of welding, brazing, and resin bonding, all of which will have their impact on the fabrication of postwar aluminum products.

Developments in the field of aluminum finishes continued at a rapid pace. Electrolytic processes have been further perfected and peacetime customers of aluminum will find the metal finished in practically every color of the rainbow.

Commercial electroplating of aluminum is now available for many types of products. Nickel, copper, silver, chromium and gold plating can be applied now to aluminum using a zinc immersion procedure.—J.A.L.

C. C. HERMANN *Consulting Engineer, Grosse Pointe Park, Mich.*

Design of Hoods for Efficient DUST REMOVAL

An increasingly important phase of plant operation is the removal of atmospheric contamination, such as dust, fumes, etc., for the protection of personnel and equipment. Despite the wide use of dust control systems, their design often rests on a rather empirical basis. Some practical pointers on the design and installation of dust control equipment are given in a series of articles by an engineer who has had wide experience in such work. The first of this series deals with hood design while later articles will include such subjects as ductwork, dust collectors, and dust disposal systems.—*Editors*

WHAT A pleasure it would be to live and work in an atmosphere devoid of dust,. fume, smoke and mist. However, wherever there is industry there are bound to be some unfavorable atmospheric conditions. The degree of contamination of the atmosphere depends basically upon the type of industry and the process methods used.

The process industries are engaged in the reduction of materials, and along with reduction comes dust, fume, smoke, and mist or vapor. Although considerable dust may be produced in these operations, it does not follow that dust dispersion into the general atmosphere must be present. Control of the dust, fumes, etc., can be possible by employment of one or more of the following methods: Segregation, enclosure of the process and exhausting to a dust collector, and wetting the dust.

Segregation of dust producing operations can only be employed in cases of complete mechanical operation. From 60 to 80 percent of the grievances by employees in most plants use working conditions as the complaint. Undoubtedly a considerable proportion of the remainder are directly traceable to the same basis. For example it is a common statement among workers, "If they want me to work in that dusty place they will have to pay more money." Not a sound demand, to be sure, nevertheless a reasonable attitude. Consequently industry must pay more and more attention to the existing working conditions within the plant and dust, fumes, smoke and vapors are by far the most prominent offenders. To segregate dusty operations which require even infrequent presence of employees is not the answer.

Wet methods, too, are very limited in their application since only a few of the many dust-producing operations can be treated this way.

The answer to the problem of dispersion of such contaminants is: (1) Elimination of the source of the contaminant, (2) prevention of dispersion of the contaminant by installation of removal devices at the source, (3) prevention of the return of the contaminants to the work room by adequate and efficient separation and final disposal.

The present series of articles will, therefor be devoted to several important phases of the subject including the following: (1) Design and installation of suitable hoods to be located at the source of the dust, fumes, etc., to prevent dispersion of the contaminant into the general atmosphere, (2) the removal of collected dust, fumes, etc., to a central separation plant and the release of clean air to the atmosphere; also the introduction of fresh air into the work room to replace that which has been removed, (3) the final disposal of the collected dust to prevent subsequent dispersion and recontamination of the air.

WHAT IS DUST?

Before leaving this general discussion it will be in order to define dust, fumes, smoke and vapor. Dust is an air-borne solid and is produced by reducing earthy material to small particle size. The particle size may range from the clearly visible to the submicroscopic. The particles of large size or visible dust in the atmosphere follow the same laws as particles which can only be seen by aid of the microscope. All floating particles are attracted toward the earth by gravity, the large particles falling at a higher rate than the smaller. The rate of settlement is dependent, to very large extent, on counter-currents, convection currents and air resistance. It is conceivable that a particle may be so small that it will act more like a gas than a solid and therefor possess Brownian motion.

It was stated above that all floating particles are subject to gravity of the earth. Particles of dust do not, however, fall according to the usual laws of gravity. Due to the minute size the rate of fall soon produces a resistance equal, or nearly so, to the gravitational forces and a new or terminal settling rate is in effect. This is important since it shows that the mere removal of a portion of the air from a dust producing operation is insufficient to remove all of the dust. Dilution of a dusty atmosphere can be misleading since the dust concentration can thus be built up to a hazardous point.

FUMES, SMOKE AND MISTS

Fumes may be the products of combustion, sublimation and condensation. Examples are plentiful in lead burning operations, melting furnaces for aluminum and magnesium, zinc oxide and many others in the chemical industry. In many cases fumes are far more harmful than dust, a characteristic being that they will contaminate the entire surrounding atmsophere much more rapidly than dust. Considerably more air must be handled for fume removal than for dust removal due to this fact.

Smoke is oftentimes mistaken for fumes and vice versa. In this article, smoke is defined as having an organic origin such as burning wood, tobacco, any vegetable matter, coal, etc. Smoke, being a product of combustion, may contain sulphuric acid and many other acids and gases which make its

elimination extremely difficult and problematical.

Mists or fogs or vapors are, as the terms imply, derived from liquids either by atomization, vaporization or boiling. An atmospheric fog may be produced by absorption of enough moisture by the air to bring it to or near the dewpoint which is 100 percent relative humidity. Sulphuric acid vats produce a sulphuric mist as do chromic acid, nitric acid and others. These conditions are common in plating shops and in chemical plants.

REMOVAL AT SOURCE

The practical and most efficient method for removal of dust, fumes, smoke, etc., is by means of enclosures or hoods located at the source of contamination, over, around and upon the machine or device producing this condition. Suction is applied to such inclosures or hoods by means of an exhaust fan and connecting duct system. Since the duct arrangement is dependent upon the individual plant arrangement the present article will be devoted to the consideration and design of enclosures and hoods for various and specific operations leaving the connecting duct work design for a later article.

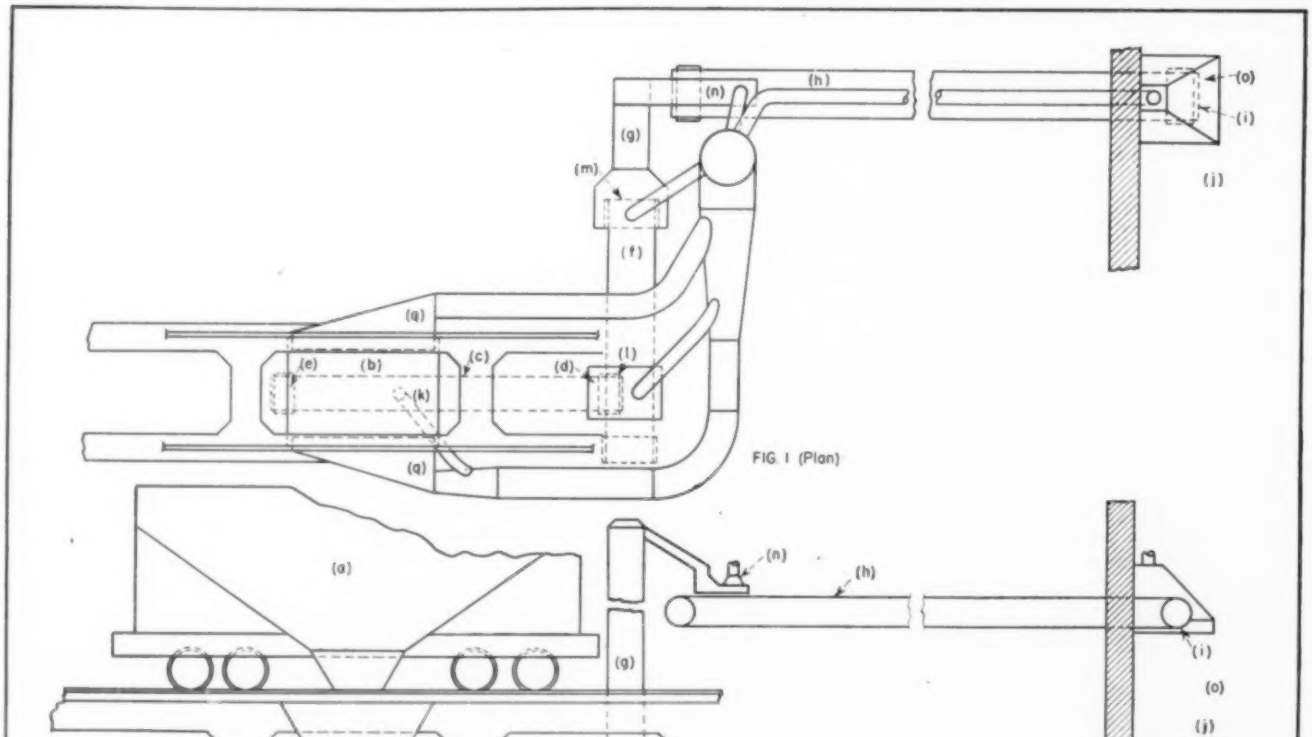
The processing of materials generally involves belt conveyors magnetic separators, crushers, screens, storage bins and mixing apparatus. Other devices producing dust are dumps, dryers, pneumatic conveying systems and bagging operations. All of the methods and devices mentioned are concerned with dust, therefore we will confine ourselves to the dust problem leaving all consideration of fumes and smoke for later articles.

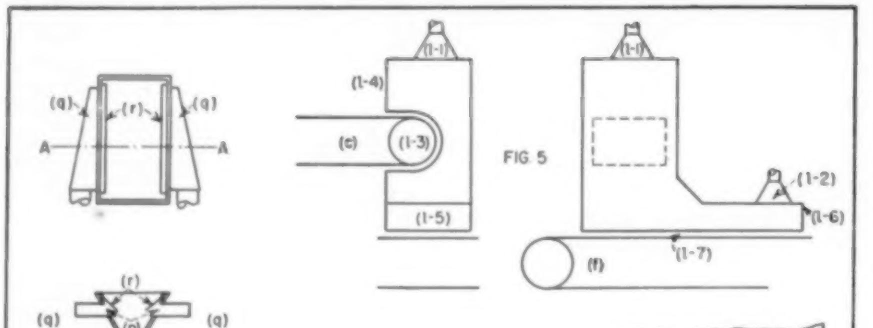
The proper point to start with a dust elimination system is at the receiving station. Materials may be received in cars or trucks, the unloading of which will produce considerable free dust. In Fig. 1, a plan view and Fig. 2 an elevation, are shown the principal elements of a receiving station. Although a gondola bottom dump car is shown at (a) this could be any other type of railroad car or it might be an auto truck. Below the car, which is positioned on an elevated track over a pit, is indicated a hopper (*b*), below this a conveyor (*c*) operating on power-driven pulley (*d*) and end pulley (*e*). A cross conveyor (*f*) conveys the material delivered from the belt (*c*) to the boot of a vertical elevator (*g*) which in turn delivers the material to a distribution belt (*h*) to the unloading point (*i*) in the storage bin (*j*). The distribution belt (*h*) could be of any reasonable length and be provided with any number of discharge points by using belt unloaders where desired.

DUST POINTS

There are a number of points in this system where dust may occur. A considerable volume will be produced in the hopper (*b*) or above same and around the car or truck bottom. Dust will be produced at the point (*k*) where the material is spread out on the belt conveyor (*c*), at the point (*l*) where the material is transferred from belt (*c*) to cross belt (*f*), at the point (*m*) where the material is transferred from belt (*f*) to the boot of the elevator (*g*), at the point (*n*) where the material is delivered to the distribution belt (*h*) by the elevator (*g*) and at the discharge point of belt (*h*) in the vicinity of (*o*) within the bin. In fact considerable dust is apt to be generated here by virtue of the great distance the mate-

Figs. 1 and 2—Views showing principle elements of a receiving and unloading system





Four views showing detailed hood design at various points in the system: Fig. 3—Hopper; Fig. 4—Hopper to belt transfer; Fig. 5—Belt transfer point; Fig. 6—Elevator base

rial must fall to the storage pile in an empty bin.

In the treatment of the hopper (*b*) to provide proper ventilation, the tendency for the dust produced by the material falling from the car to the hopper will be to escape to the general atmosphere up through the railroad track and around the top of the hopper. For this reason, very large air take-off must be provided at the hopper; in fact this must be sufficient to cause a drift of the general atmosphere downward into the hopper rather than upward and away from same. This is not too difficult to accomplish since the estimated clearance should not exceed 40 sq. ft. and by allowing 200 ft. per min. velocity this would be 8,000 cu. ft. per min. of air to exhaust from the hopper.

HOPPER VENTILATION

Fig. 3 shows a view of the hopper ventilation and since this same system may be used on many hoppers of this type it is considered in some detail. The first consideration is to select an orifice velocity which will only remove the dust produced by separation of the material as it drops through space into the hopper. A velocity of 1,500 ft. per min. should be used at the air duct orifice (*p*). Since this orifice is in fact a long slot cut into the side of the hopper considerable material could fall directly into the air chamber (*q*). To prevent this a baffle plate (*r*) is placed within the hopper directly above each orifice or slot and sloping away sufficiently to provide air flow space between the lower edge of the baffle and the hopper side. Any material falling on the baffle will be deflected away from the seat but air-borne solids will flow through the slot together with the air.

Since 8,000 cu. ft. per min. must be exhausted through the two slots or 4,000 cu. ft. per min. through each, and we have selected an air velocity of 1,500 ft. per min., the open area of the slot must be 2⅔ sq. ft. The slot should extend the width of the hopper. If this measures 8 ft. the width of slot must be ⅓ of a foot or 4 in. In other words the slot on each side of the hopper must be 4 in. wide x 96 in. long. The air ducts connecting each hood to the disposal point are observed in the plan view, Fig. 1.

Material dumped into a hopper such as illustrated may nearly fill it and, due to the weight of material, a pressure is produced at the outlet. In this case the outlet is at the point (*k*) which also designates a dust take off point. In Fig. 4 is shown an enlarged view of this type of distributing hood and dust connection. The dust laden air is drawn off through an air duct attached to the collar on top of the hood. The air inlet is at the back of the hood (*k*-1) and through the gap between the hood side sheets and the belt at (*k*-2). Some air will come in through (*k*-3) where the material passes out from beneath the hood on the belt (*c*). If the belt is 24 in. wide the hood should be made 22 in. wide since the side skirt must be over the belt. Since the height of the opening at (*k*-1) and (*k*-2) is 12 in., it is common practice to hang a leather strip over these openings to cut down the air leakage. The effect of this is to reduce the leakage about 25 percent giving an open area of 1½ sq. ft. for each end. Also the distance between the lower edge of the side skirt and the belt is 1½ in. making ¾ sq. ft. of open area for the two sides. The total open area is then 3¾ sq. ft. which when multiplied by 200 ft. per min. velocity provides 750 cu. ft. per min. of air removal to ventilate this point.

BELT TRANSFER POINTS

The next important dust hood is the belt transfer point (*l*), Figs. 1 and 2, which requires a hood design similar to that shown in Fig. 5. The belts (*c*) and (*f*), both 24 in. wide, are positioned at right angles to each other. The hood is so designed that it may be assembled sidewise covering the end pulley of belt (*c*) with the distribution chamber extending at right angles over the belt (*f*).

It was determined that 750 cu. ft. per min. was sufficient to remove the dust from point (*k*). Only 75 percent of this is necessary at (*l*-1) since dust is also exhausted at (*l*-2). The maximum open area about the hood should be about 5¼ sq. ft. The largest open area is at (*l*-3) around the end pulley of belt (*c*). If this pulley is of 14 in. diameter the opening in the hood, to provide ample clearance, should be 18 in. The open area above the belt at (*l*-4) is 1½ sq. ft. Since the hood extends 3 in. beyond the belt at each side there are two openings 3 in. wide and 18 in. long or a total of ¾ sq. ft. The belts (*c*) and (*f*) are on 48 in. centers and there is no cover sheet at (*l*-5) for a distance of 12 in. allowing 1 sq. ft. of area here. At point (*l*-6) there is an open area of 1 sq. ft. and since the length of this hood is 48 in. and the side clearance is 1½ in. the side open area is 1 sq. ft. making a total of 5¼ sq. ft.

The hood at the boot of the elevator is shown in detail in Fig. 6. This hood fits right on top of the boot and includes the end of the belt (*f*). The open area of this hood is at (*m*-1) and (*m*-2) which is the same as similar points described above for Fig. 5 and amounts to 2¼ sq. ft. It is advisable to place the elevator under a slight suction to avoid sifting of dust through loose joints so it is desirable to use 750 cu. ft. per min. as the ventilating volume at this point.

The distribution point within the storage bin is a difficult one to handle due to the large volume of the bin and the great distance the material usually falls in reaching the storage pile. This point, however, is one which can be more or less segregated and is therefore treated as such. Some air for ventilation is removed, however, and a hood having face dimensions of 48 in. x 48 in. is placed over the end of the belt. A duct take-off is provided at the top of

the hood to handle 1,000 cu. ft. per min. of air for each 10,000 cu. ft. of total volume in the storage bin. This would provide six air changes per hour which is sufficient to prevent dust escaping from the inclosed area.

Belt transfer points of all kinds may be treated in the same manner as shown in the foregoing paragraphs. For belts of different widths it is best to use an air volume equal to 375 cu. ft. per min. per foot of belt width. Where the material handled is below average in dustiness, this figure may be scaled down to 300 cu. ft. per min. per ft. of belt width.

SCREENS

Screening of fine material is an important operation in the process industries and is a very heavy dust producer. Screens are of two general types namely, the rotary screen and the vibrating screen. The rotary screen may be either cylindrical or hexagonal. In either case the material is fed to the high end passing through the screen to a belt conveyor located below with a tailings conveyor at the lower end. Fig. 7 shows how to hood the screen properly to capture the dust at this point. The air inlet is provided along the lower portion of the screen and the dust is removed by two air take-offs at the top evenly spaced for the length of the hood. No further dust hood is required for the inlet end of the screen. But it is usually advisable to take an air duct off the screen chute and belt head hood at the screen discharge.

The required air for properly ventilating the screen is based on the cross sectional area of the screen. Experience indicates that not less than 75 cu. ft. of air per min. should be removed per sq. ft. of cross section area so that for a 5 ft. x 10 ft. cylindrical screen the air volume would be 3,750 cu. ft. per min. This may be varied one way or the other depending on the volume of fines to be taken out.

Since vibrating screens are flat, multiple stage units may be built by the use of two or more screens placed one below the other. The inlet is located at the top end and the screen is installed with a slope from inlet to discharge. Although the dust produced by the material dropping onto the screen is adequately handled by the screen ventilation it is generally necessary to install a hood and some ventilation over the belt at the discharge end.

For the screen proper a hood such as shown in Fig. 8 may be used because this type of hood will eliminate the excessive removal of fines and thus prove economical. The hood is designed with ample doors or removable plates to permit access for replacement of screens and maintenance of the vibrators. The air volume for ventilation is calculated on the basis of 75 cu. ft. of air per min. per sq. ft. of screen box area. That is, for a 5 ft. x 8 ft. screen the volume of air would be 3,000 cu. ft. per min. The removal of air at the hopper discharge hood is based on the figure of 300 cu. ft. per min. per foot of belt width, minimum. The dust hood would be similar in design to that shown in Fig. 4.

It is impractical, in an article of this type, to indicate sufficient detail to cover every possible situation and requirement. However, current problems such as equipment maintenance should be considered. Hoods should be so constructed that they are not a hindrance to the maintenance crews for if such turns out to be the case difficulties will be encountered in keeping the hoods in continuous service. Maintenance men often inadvertently remove hoods or parts of hoods and neglect to reinstall them after the job is finished. The hoods should be made easily removable where necessary and provision should be made for easy lubrication of the machinery they cover.

DESIGN FOR EASY MAINTENANCE

Hoods should be ruggedly built of sufficiently heavy members and of not less than 16-ga. sheet steel. Heavier construction is desirable if considerable abrasion may take place. Welding of joints is highly recommended to provide rigidity with the least possible weight of material for the strength obtained. If plates are bolted to facilitate changing of parts they should be made easy to remove and as easy to replace again. In this case the number of bolts should be kept to the minimum and they should be welded in so the plate can be removed by just taking off the nuts. Wing or thumb type nuts should be used where possible. Hoods should be painted the same color as the body of the machine they are mounted upon but it is good practice to paint the machine surface covered by the hood an entirely different color such as yellow, or red to make the absence of the hood conspicuous if left off.

Figs. 7 and 8—Types of hoods for removing dust from rotary and vibrating screens

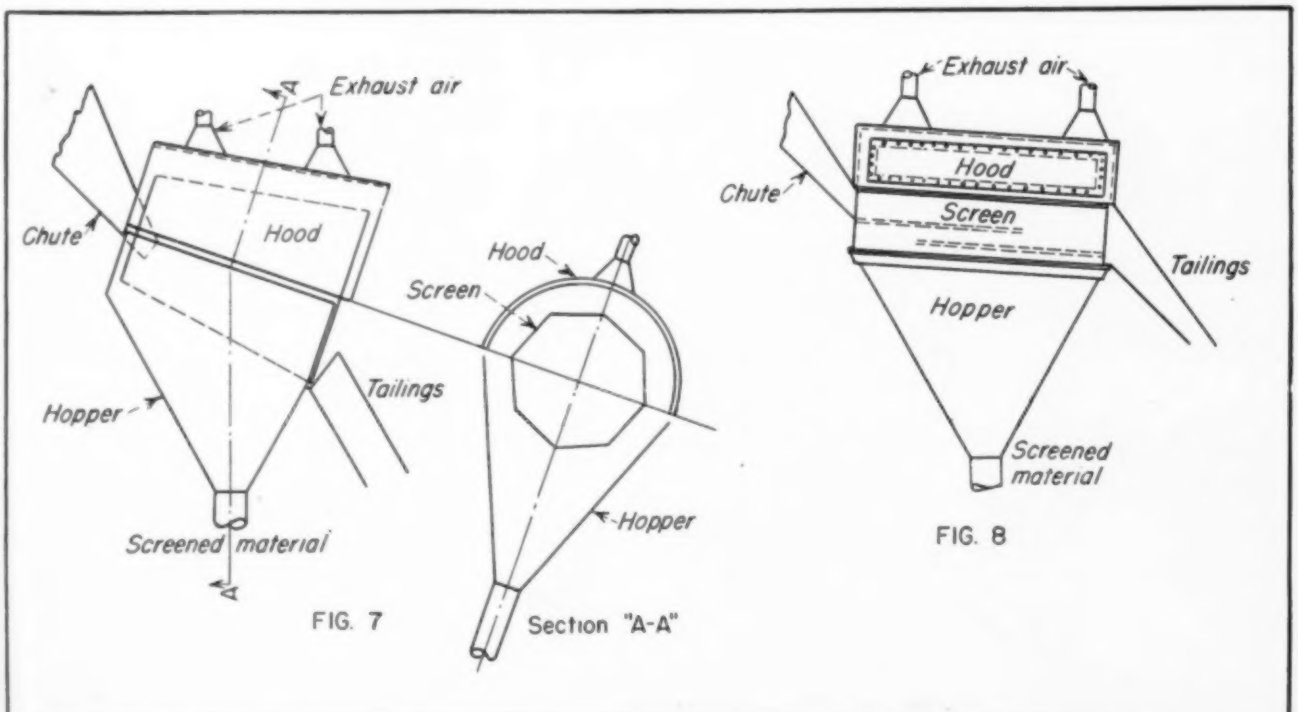
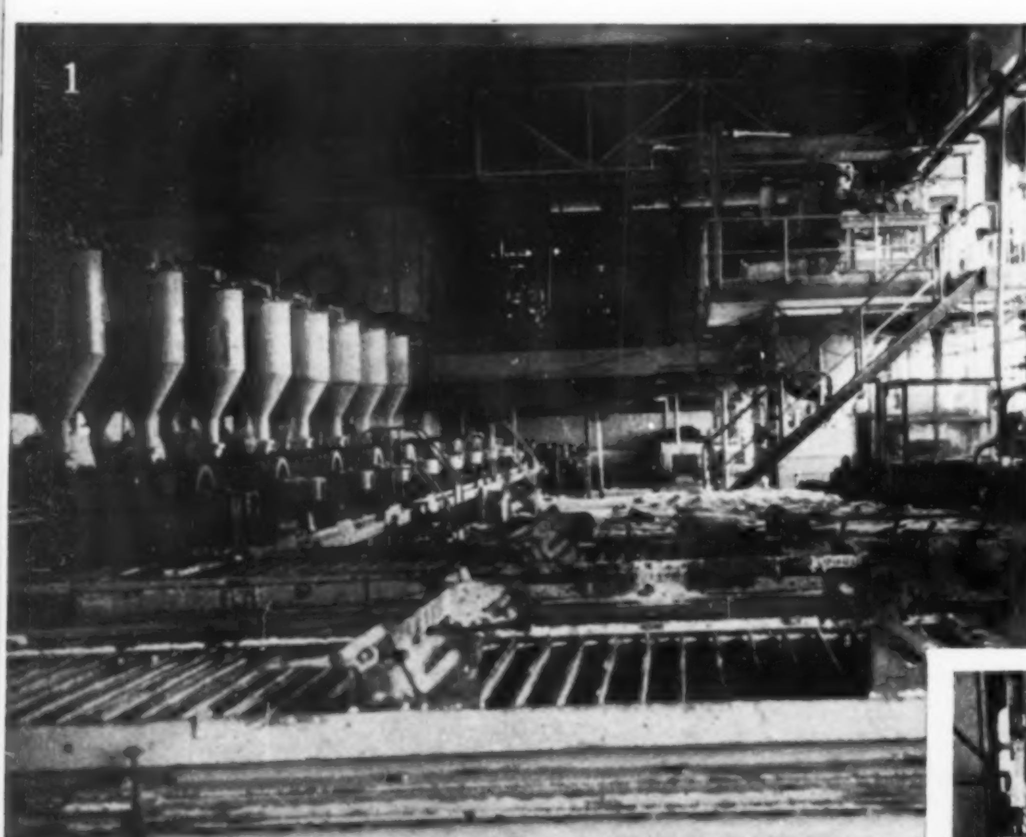


FIG. 7

FIG. 8

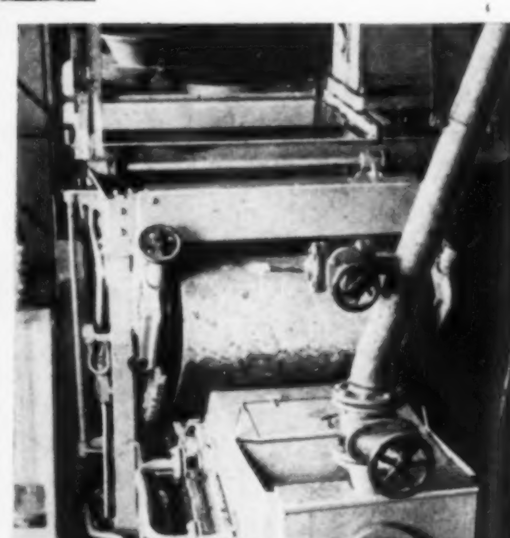
GERMAN FIBERS



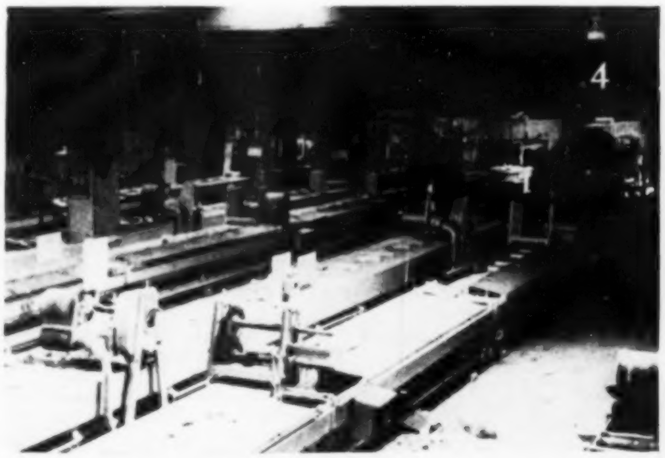
1 In foreground is ordinary batch steeping press of type common in America. Behind and to the left of it is a bank of continuous screw presses (I. G., Wolfen), each with capacity of 1½ tons pulp per day. Presses of 8-ton capacity are also reported

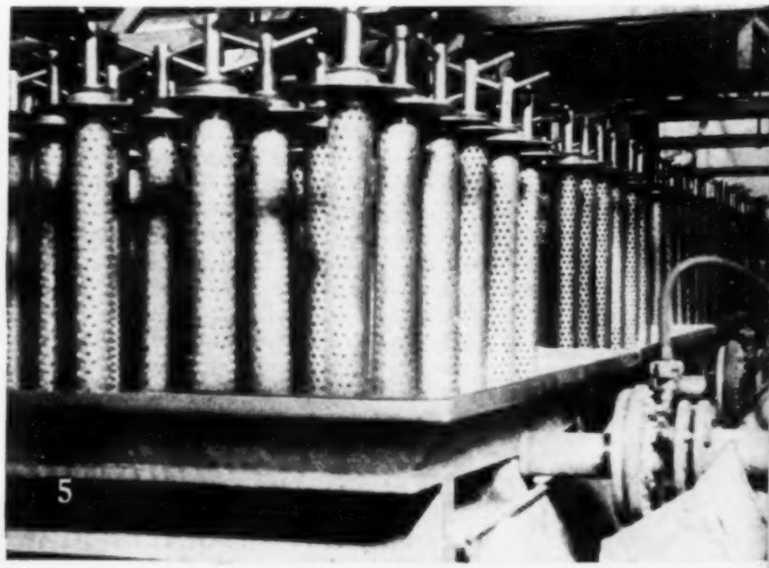
2 Damaged press shows diminishing pitch of screw which gives press ratio of 2.7:1 and squeezes out excess caustic through slots in casing. Small hoppers can be placed under press to separate solution into two portions of different hemicellulose content

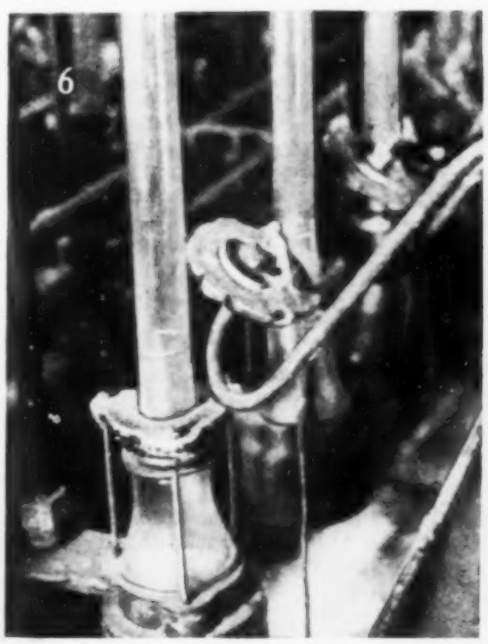
3 Here causticized pulp is fed to a different type continuous press (Siegberg) consisting of two heavy gage stainless steel belts running between converging pressure rollers

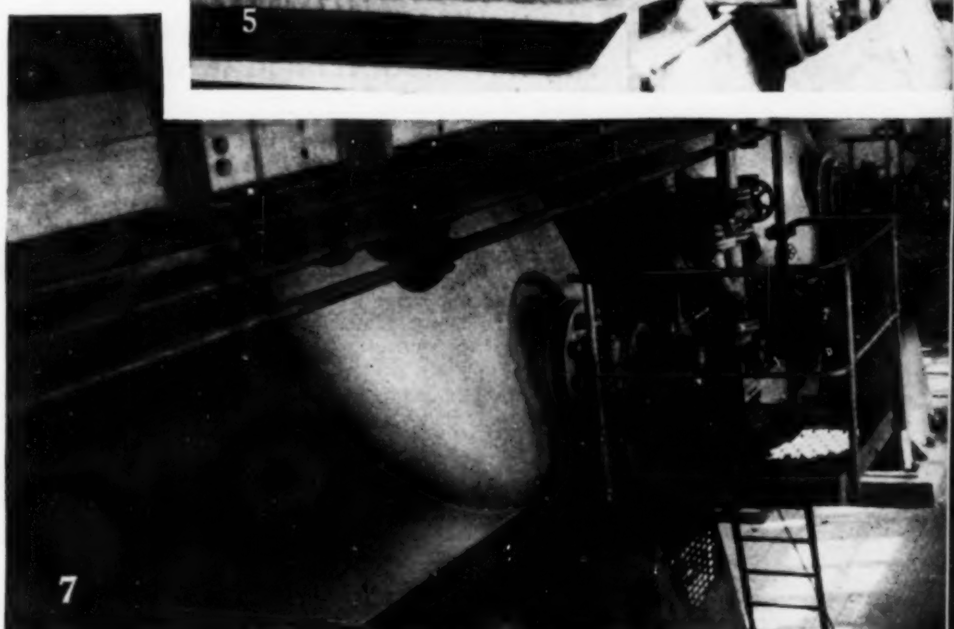


GERMANY'S rayon and synthetic fiber industry has turned some neat tricks, a few of which are illustrated here. Unlike American practice, most large German viscose plants employ slurry steeping and continuous pressing and aging (Figs. 1-3). The trend toward continuous processing is exemplified also in staple finishing and treating machines (Fig. 4). Several random items of equipment are equally interesting for their novelty; these include cake washing machines, vertical polyvinyl chloride spinning tubes, and some very large eccentric viscose xanthators (Figs. 5-7). Further details on these and other features of the industry can be obtained by ordering OPB Report 377, "Continuous and Staple Fibre Plants in Germany," Office of the Publication Board, Department of Commerce, Washington 25, D.C. (224 pages, $2)









4 Continuous viscose staple machines at Wolfen. Each is 400 ft. long and consists of 19 shallow treating tanks with squeeze rolls between. "Spinnband," or tow, is held submerged by rods; tanks are covered to effect CS_2 and H_2S collection

5 Machine at Uerdingen for washing bucket spun cakes. Perforated holders accommodate five cakes apiece and are mounted on scow-shaped carriages. Machine has five positions, three for water wash, one for sodium sulphite, and one for soap treatment. Carriages move at 15 min. intervals from one position to next; at each position wash liquor comes in through inflatable-gasket connection (lower right) and flows to individual holders through distributor pipes in bottom of carriage. Sump under each carriage collects liquor for recirculation

6 Bottom of 7½-ft. glass spinning funnel for polyvinyl chloride (Wolfen). PC is extruded upward through spinneret (here detached from bottom of funnel) and coagulates in water which enters bottom of funnel and overflows at top

7 At Wolfen CS_2 is added to alkali-cellulose in these eccentrically mounted, squat cylindrical barattes, each with a volume of 650 cu. ft. Baratte is jacketed for water cooling, rotates 4-5 rpm., and xanthates 4-ton batch in about three hours

CHEM. & MET. PLANT NOTEBOOK

THEODORE R. OLIVE, Associate Editor

$50 VICTORY BOND FOR A GOOD IDEA!

Until further notice the editors of *Chem. & Met.* will award a $50 Series E Bond each month to the author of the best short article received during the *preceding* month and accepted for publication in the "*Chem. & Met. Plant Notebook.*" Articles will be judged during the month following receipt, and the award announced in the issue of that month. The judges will be the editors of *Chem. & Met.* Non-winning articles submitted for this contest may be published if acceptable, and if published will be paid for at space rates applying to this department. (Right is reserved, however, to make no award in months when no article received is of award status.)

Any reader of *Chem. & Met.*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are criteria of the judging.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address entries to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

JANUARY WINNER!

A $50 Series E Savings Bond will be issued in the name of

W. L. Jacobs and
F. M. Hildebrandt

U. S. Industrial Chemicals, Inc.
Baltimore, Md.

For an article dealing with a new and improved type of decanter for pilot plant liquid separation that has been judged the winner of our January contest.

This article will appear in our March issue. Watch for it!

December Contest Prize Winner

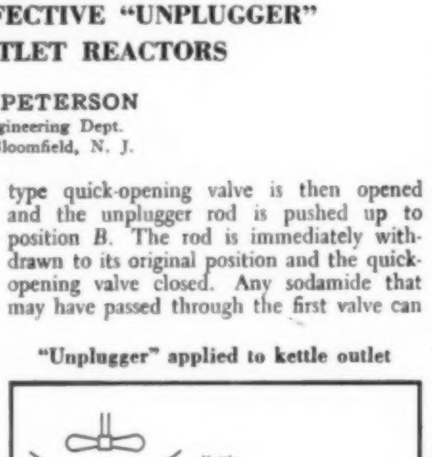
HOW TO BUILD AN EFFECTIVE "UNPLUGGER" FOR BOTTOM-OUTLET REACTORS

LESTER H. PETERSON
Development Engineering Dept.
Schering Corp., Bloomfield, N. J.

In making sodamide in a glass-lined, bottom-outlet kettle we experienced trouble in unplugging sodium from the well at the bottom of the reactor. The problem was solved very successfully by the development of an "unplugger" of the type illustrated below. Referring to the illustration, a piece of round stock was threaded into a standard tee, while the opposite end was turned as shown to the female end of a stuffing box. A hole large enough to enable a rod to slide freely was drilled lengthwise through the body of the stock. Addition of the rod and a packing gland and packing nut completed the special parts that had to be supplied. The remaining parts of the discharge arrangement were of standard pipe and fittings.

The unplugger is operated as follows: The gate valve at the right is closed. Initially the rod is in position *A*. The disk type quick-opening valve is then opened and the unplugger rod is pushed up to position *B*. The rod is immediately withdrawn to its original position and the quick-opening valve closed. Any sodamide that may have passed through the first valve can then be metered through the gate valve, while a petcock threaded into the body of the tee enables the liquid remaining in the lower part of the tee to be drained after cleaning.

"Unplugger" applied to kettle outlet



An unplugger of the type described here should prove valuable on kettles used for any type of reaction where the initial reactants tend to stick in the well of the reactor, or where heavy salts that settle out are formed in the reaction.

COMING IN MARCH

In the March issue of *Chem. & Met.* will be the announcement of a new plan for the Plant Notebook Contest. We think you will like it. Watch for it on this page.

TRIANGULAR CHARTS PERFORM LOGARITHMIC OPERATIONS

M. M. REYNOLDS
Engineering Experiment Station
University of Colorado
Boulder, Colo.

Some months ago (*Chem. & Met.*, August 1945, p. 104) the author presented an article describing how triangular charts can be used to add and subtract and, as a consequence, can be employed in the construction of graphs to solve certain sorts of problems with complex sets of multi-variables. Such a problem, for example, is the one of determining the total return on a manufacturing operation when both raw material cost, and product and byproduct selling prices, may vary. By using as many triangles —each properly calibrated—as there are additions or subtractions to be carried out, it was shown how various graphical solutions can be built up.

The accompanying charts show that the triangular method can be used also for multiplication, division and the solution of power functions, for use where operations of this sort might be needed in combination with addition or subtraction in a graphical multi-variable chart. The method is to calibrate

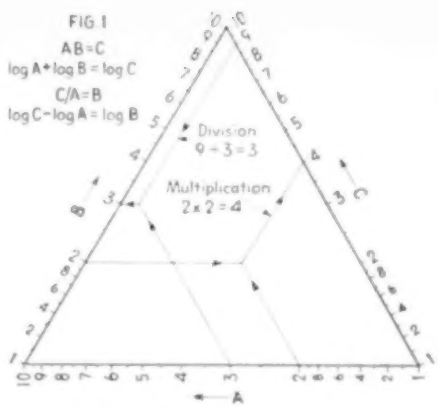


Fig. 1—Triangular chart for multiplication and division

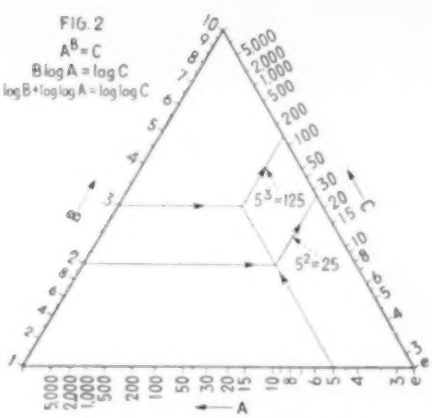


Fig. 2—Triangular chart for solution of power functions

the scales logarithmically rather than linearly and then add or subtract the logs or log logs as the case may be. As the first article pointed out, two sides of one of the triangles may be calibrated in any way desired, but once this is done, the way in which the third side is calibrated is fixed. In Fig. 1, for example, side A might have been calibrated from 10 to 100 and side B from 1 to 10, but in that event, side C would have had to be calibrated from 10 to 100. In Fig. 2 the calibration of sides A and C starts with e (2.71828+) but it could have started with 1 or any other number.

To use the method for multiplication (or division) as in Fig. 1, the scales are calibrated logarithmically. Then, to multiply A by B, $\log A + \log B = \log C$; or to divide C by A, $\log C - \log A = \log B$. To multiply on the chart, enter at B and A and follow the arrows on the lines marked "multiplication" to the product C. To divide, enter the chart at C and A and follow the arrows on the lines marked "division" to the quotient B.

To use the method for power functions, as in Fig. 2, the exponential scale B is calibrated logarithmically, while scales A and C are supplied with a log log calibration. This follows from the fact that if $A^B = C$, then $B \log A = \log C$ and $\log B + \log \log A = \log \log C$. Hence, to accomplish the operation by addition the scales must be put in a form in which addition will produce the desired result.

FILTRATION TECHNIQUE FOR FLUORSPAR CONCENTRATES

A recent issue of the *Deco Trefoil*, published by Denver Equipment Co., gives some interesting suggestions regarding the filtration of fluorspar flotation concentrates. Acid grade fluorspar as normally produced by flotation is ordinarily difficult to filter since the fatty acid flotation reagent tends to blind the filter cloth, requiring frequent expensive cloth changes. To remedy this the usual canvas or palma twill filter medium is replaced with stainless steel held in place with stainless banding wire. The relatively coarse mesh is unaffected by the sticky soap reagent and permits free filtration.

A definite technique, however, is needed. A much higher vacuum pump displacement per square foot of filter surface must be used and it is necessary first to precoat the drum with concentrates to prevent particles from passing through. It is customary to set the scraper blade with a ½- to ¾-in. clearance so as to leave enough cake on the drum to act as a filter medium. As often as this surface shows a slight loss in efficiency, low pressure air is used (several times a shift) to remove the cake. This method results in little or no deterioration of the stainless wire. One large fluorspar flotation plant has operated in this way for nearly three years without a cloth change.

Under favorable circumstances with minimum slimes this method yields a filtering rate of 4 or more tons per day per square foot of filtering area. If considerable slime is present and more frequent cleanings are needed a diaphragm filtrate pump will be preferable to a centrifugal pump owing to the extra solids to be handled in more frequent precoating.

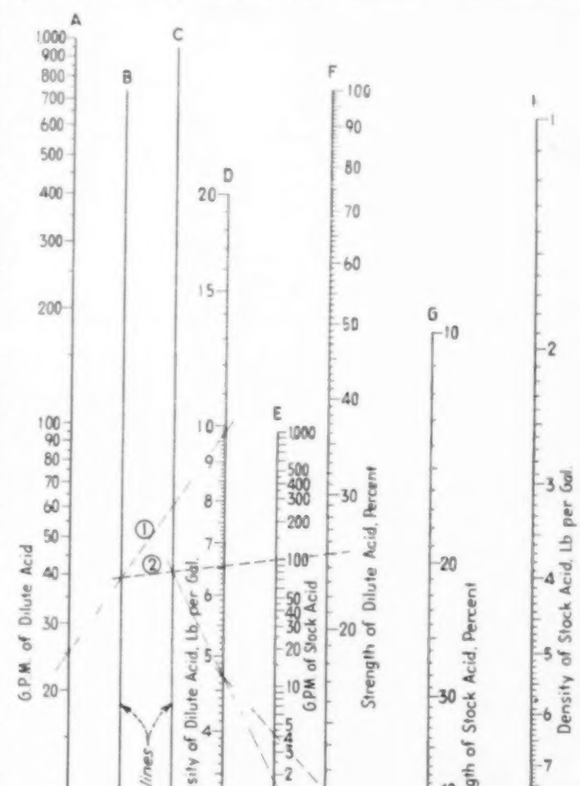
SULPHURIC ACID NOMOGRAPH

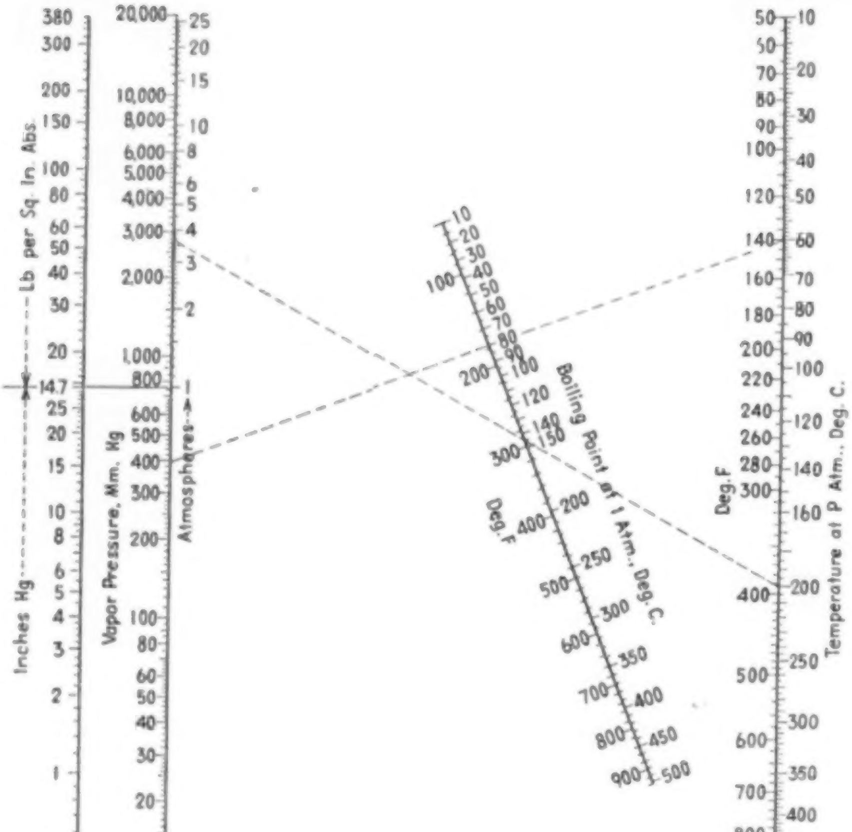
How many gallons per minute of 98 percent sulphuric acid weighing 15.37 lb. per gal. is needed to yield 25 g.p.m. of 25 percent acid, weighing 9.85 lb. per gal.? On scale *A* connect 25 g.p.m. with 9.85 on scale *D*. Connect intersection of line (1) and reference line *B* with 25 on scale *F*. Connect intersection of line (2) and reference line *C* with 98 on line *G*. Connect intersection of line (3) and reference line *D* with 15.37 on line *H*, reading 4.1 g.p.m. of 98 percent acid on line *E*. Required water is 25—4.1=20.1 g.p.m.

CONTINUOUS DILUTION CHART FOR SULPHURIC ACID

ANTHONY BUNK
Chemical Engineer
Greenwich, Conn.

Ordinarily charts for the dilution of sulphuric acid are based on weight, rather than flow rate. However, where a continuous flow of acid of known strength is to be diluted continuously to produce a weaker acid of specified strength, the accompanying nomographic chart will be found more convenient. Knowing the desired flow of the weak acid, as well as the percentage and pounds per gallon of both the weak and the strong acid, the chart gives directly the required gallons per minute of strong acid and, by difference, the rate of water flow needed





Vapor pressure nomograph for non-branched paraffinic hydrocarbons

to give the desired dilution. The method of use will be evident from the numbered lines given on the chart, and from the problem detailed in the caption.

CHART FOR VAPOR PRESSURES OF HYDROCARBONS

ERNST BERL
Professor Emeritus
Carnegie Institute of Technology
Pittsburgh, Pa.

Developed originally by the author together with his collaborators, W. Herbert and W. Wahlig, the accompanying nomographic chart has been modified to include Fahrenheit temperatures and engineering units for pressure. It is based on an empirical formula of O. G. Wilson (*Ind. Eng. Chem.*, **20**, 1363, 1928) and permits the determination of boiling points of non-branched paraffinic hydrocarbons at a pressure of 1 atm., if vapor pressures between 10 and 20,000 mm. Hg are known, together with the corresponding temperatures between 10 and 500 deg. C. Conversely, when the boiling point at 1 atm. is known, vapor pressures at various other temperatures can be determined. In most cases data for branched paraffins, naphthenes and aromatics can be taken with sufficient accuracy from this nomograph.

Example 1—A hydrocarbon boils at 145 deg. C. (294 deg. F.) at a pressure of 760 mm. Hg (1 atm., 14.7 lb. per sq.in.). What is its vapor pressure at 200 deg. C. (392 deg. F.)? Connect 200 deg. C. on the right hand temperature scale with 145 deg. C. on the middle temperature scale, extending the line to the vapor pressure scale at 2,790 mm. Hg (3.65 atm., 53.6 lb. per sq.in.).

Example 2—If the vapor pressure of a paraffinic hydrocarbon is 395 mm. Hg (15.55 in. Hg) at 60 deg. C. (140 deg. F.), what is its boiling point at atmospheric pressure? Connect 395 mm. on the vapor pressure scale at the left with 60 deg. C. on the right hand temperature scale. The line crosses the atmospheric boiling point line at 80 deg. C. (176 deg. F.).

MORE ON DESIGN OF A SPIRAL RIBBON

CHESMAN A. LEE
Engineer
Darling & Co., Chicago, Ill.

In the September issue (*Chem. & Met.*, September 1945, p. 122) A. B. Porter developed equations for determining the size of circular blanks to be cut out in forming a spiral ribbon for mixers and conveyors. His equations involved certain approximations, but it is possible to develop exact equations that are still simple to use.

In Fig. 1 the problem is indicated. It is desired to find what inner and outer radii r' and R' are necessary to form a helix with pitch P and with inner and outer radii r and R. From the geometry, if k is the tangent of the helix angle, then $P = 2\pi R k$.

Now, using a passing touch of calculus, it is not difficult to analyze an elemental segment of the helix. Fig 2 shows a projection of the segment on a plane perpendicular to the axis. If the length of the inner edge at radius r is $r\,d\alpha$, then the length of the outer edge at radius R is $R\,d\alpha$. Again from the geometry, the pitch of the segment is $k\,R\,d\alpha$, from which the actual (not projected) lengths of the two edges can be determined by right triangles. The outer edge is equal to

$$\sqrt{(Rd\alpha)^2 + (kRd\alpha)^2} = R\sqrt{1 + k^2}\,d\alpha$$

and the inner edge is equal to

$$\sqrt{(rd\alpha)^2 + (kRd\alpha)^2}$$

If $c = r/R$, then the inner edge is equal to

$$R\sqrt{c^2 + k^2}\,d\alpha.$$

When the elemental segment is spread out flat its dimensions do not change although the radii of the two edges must do so. Fig. 3 shows the spiral segment flattened out. Since the lengths of the edges vary as their radii, then:

$$\frac{R'}{r'} = \frac{R\sqrt{1 + k^2}\,d\alpha}{R\sqrt{c^2 + k^2}\,d\alpha} = \frac{\sqrt{1 + k^2}}{\sqrt{c^2 + k^2}}$$

But $R'/r' = (r' + w)/r' = 1 + w/r'$. Hence

$$r' = w \div \left[\frac{\sqrt{1 + k^2}}{\sqrt{c^2 + k^2}} - 1\right]$$

As an example, take a 12-in. diam. helix of pitch 12 in. on a 4-in. shaft. Here $R = 6$, $r = 2$, $w = 4$, $c = 2/6 = 1/3$, and $k = P/2\pi R = 12/12\pi = 1/\pi$. Then:

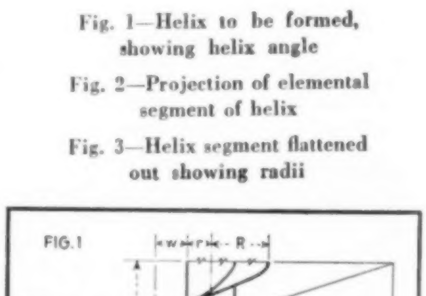
$$r' = w \div \left[\frac{\sqrt{1 + (1/\pi)^2}}{\sqrt{(1/3)^2 + (1/\pi)^2}} - 1\right] = 3.125\text{ in.}$$

Then $R' = 3.125 + 4 = 7.125$ in. and the diameter of the blank is 14.25 in.

Fig. 1—Helix to be formed, showing helix angle

Fig. 2—Projection of elemental segment of helix

Fig. 3—Helix segment flattened out showing radii



PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

KARBATE COOLER

ONLY four standard parts, available in five pipe sizes, are needed in the assembly of a new sectional cascade cooler constructed of Karbate impervious graphite and manufactures 338 deg. F. may be handled. In N. Y. Suitable for the handling of corrosive liquids and gases, the cooler features high heat transfer rates, resistance to thermal shock and freedom from corrosion scale formation. Pressures to 75 lb. and temperatures 338 deg. F. many be handled. Individual pipe sections are 9 ft. long. In the maximum recommended height of 6 ft., about 120 sq.ft. of effective external cooling surface is available in all five sizes.

ELECTRONIC FILTER

ELECTROSTATICALLY charged paper is the collecting element in another of the line of electronic filters produced by American Air Filter Co., 125 Central Ave., Louisville 8, Ky. Known as the Electro-Airmat, the filter introduces a new principle in air filtration and has an arrestance rating, according to the manufacturer, of 90 percent or better with atmospheric dust or smoke. The filter weighs 40 percent less than electronic filters having metal plate collectors and requires 30 percent less floor area. The special filter paper, known as Airmat, is composed of a number of porous plies which tend to separate, with each individual fiber becoming a collecting electrode, when electrostatically charged.

Karbate cascade cooler

Electronic air filter

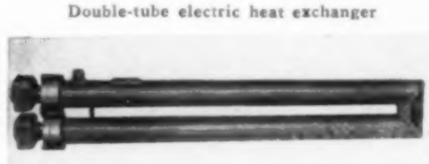
ELECTRIC HEATER

FOR LIQUID heating applications where electricity is the heat source, the Brown Fintube Co., Elyria, Ohio, has introduced a new heat exchanger employing electrical resistors. These resistors are incased in a length of standard Brownweld fintube. The current density of typical resistors now in use is 4 kw. per lineal foot of fintube. However, owing to the high ratio of exterior to interior area of this type of heat transfer tube, the rating on the outside surface is only about 8 watts per sq.in., thus, it is claimed, avoiding possibility of burning sensitive materials. Heat exchange tubes of this type can be employed in double-tube, bayonet, vertical immersion and other types of heat exchangers.

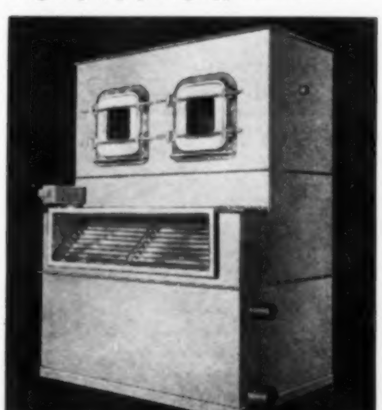
AIR CONDITIONER

TO PROVIDE for high capacity air conditioning requirements in industries manufacturing glass, matches, photographic film and other products requiring controlled humidity, Surface Combustion Corp., Toledo 1, Ohio, has developed a "package-type" heavy-duty Kathabar unit available in capacities from 10,000 to 70,000 c.f.m. Smaller units of the package type are also available for capacities to 5,000 c.f.m. In addition, the company manufactures large central-station type systems. The new unit is a vertical contactor containing both humidification-dehumidification sections and a regeneration section for the circulated chemical absorbing medium. The unit is automatic in operation, either humidifying or dehumidifying in accordance with a single control setting. Temperature control is obtained by modulating the cooling water supply to the contactor-cooler.

Double-tube electric heat exchanger



Large-capacity package-type air conditioner



MAGNETIC DRIVE

FOR USE on such equipment as fans, blowers and compressors, Electric Machinery Mfg. Co., Minneapolis 13, Minn., has developed an improved magnetic adjustable-speed drive which is shown in miniature in the model portrayed in an accompanying view. It consists of but two operating parts, a rotating ring and a rotating magnet. It is used in combination with a constant speed a.c. motor and an electronic controller to provide split-revolution speed control in capacities of 25 hp., and larger, for 1,800 to 600 r.p.m. Several types are available.

CAST ACID COOLER

USING experience gained in producing units for acid concentrators at explosives plants during the war, National Radiator Co., Johnstown, Pa., has developed a new acid cooling element known as the U-Cast Hairpin which is recommended also for the cooling of many other liquids, including strong alkalis. These elements are designed for submersion in the solution with the coolant, usually water, passing through the element itself. Sections of the unit are cast of a highly resistant gray iron said to have out-lasted by many months the cooling coils these units replaced in acid concentration service.

VOICELESS INTERCOM

TEMPORATOR is the name of a new voiceless intercommunication control now being offered by Simplex Time Recorder Co., 43

Model of magnetic adjustable-speed drive

Lincoln St., Gardner, Mass. The device is designed to bring time, cost, employee, production, materials, inventory and similar information together at a central point and to integrate and coordinate other related plant-management activities. Up to 4,000 messages may be transmitted per day directly to or from employees through one operator seated at a six-unit central control board connected with any number of substation dispatchers. Speed is attained through visible signal dialing. Communications are dialed just as a dial telephone is used. Symbols identify each production, operation, material or other information and a combination of symbols delivers any desired directive or report. The symbols are flashed upon, and are visible simultaneously at, both central control board and any designated substation dispatcher.

RUBBER INSULATED TROLLEY

Rubber insulation is used in the Trac-Troly manufactured by Benbow Mfg. Co., 20th floor, Hobart Building, San Francisco 4, Calif. The method, said to be suitable for practically all types of electrically operated mobile equipment requiring trolley power feed, employs a copper conductor encased in a slotted rubber rack supported by rigid backing, together with individual traveling collectors of "tractor-tread" construction to enforce six-tooth contact at all times. The construction is indicated in an accompanying view.

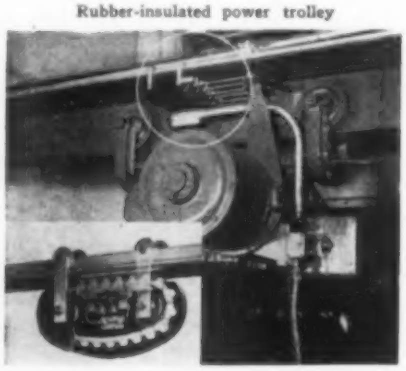
pH METER

Extreme simplicity of operation is claimed for the new line-operated pH meter recently announced by Macbeth Corp., 227 West 17th St., New York 11, N. Y. It can, it is claimed, be used satisfactorily by untrained workers since only one control in addition to the electrode switch must be manipulated. It is calibrated to read in units of 0.1 pH over the full range from 0 to 14 pH.

ROTARY PUMP

Another model in the line of rotary pumps developed by the Marco Co., Wilmington, Del., has recently been announced under the designation of Model M-100. Claimed to handle anything that can be pumped, including heavy viscous materials or light volatile materials, with a minimum of vapor lock, the pumps are equipped with an automatic compensating wear control which is said to maintain volumetric efficiency. A self-adjusting seal inclosed in steel armor is provided to hold against both pressure and vacuum. The smallest type, called the Victor, requires no lubrication while the larger Commander and Challenger designs are equipped with automatic lubrication. Maximum capacity for the smallest is 300 and, for the largest, 3,765 g.p.h.

Rubber-insulated power trolley



SCREW PUMP

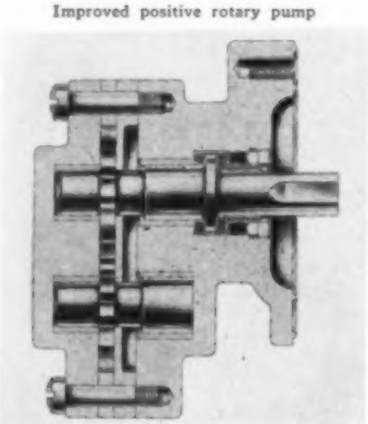
Streamlining of the design of its balanced quadruplicate screw pump has been announced by the Quimby Pump Co. division of H. K. Porter Co., Pittsburgh 22, Pa. As is shown in an accompanying illustration, portraying an improved external bearing pump, separate pedestals with their three-point alignment problem and facing washers are eliminated in the new design, which employs bracket-type, anti-friction, thrust and line bearings. Precision preloaded bearings permit closer running clearance between the body bores and the screws. The new construction can be provided on all existing pumps without disturbing present line connections or the location of the motor.

PORTABLE CONVEYOR

Inclined, declined or horizontal conveying can be accomplished with the new Standard Handibelt portable belt conveyor now being offered by Standard Conveyor Co., North St. Paul 9, Minn. Designed to handle packages such as bags or boxes, weighing up to 110 lb., or for a continuous load of 20 lb. per foot, it may be used as a feed conveyor, as a connecting link between other conveyors, or for stacking and piling purposes.

Line-operated pH meter

Improved positive rotary pump



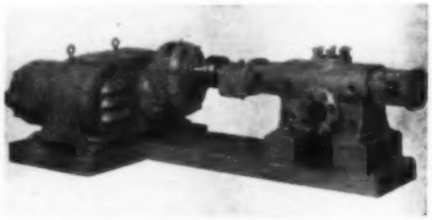
ELECTRIC LIFT TRUCK

Relieving its operator of all physical effort except that of guiding the unit, the Worksaver electric lift truck recently introduced by Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia, Pa., is available in both skid- and pallet-lift types. Loads up to 3 tons can be handled, using finger-tip pressure on the controls mounted beneath the hand bar-grip. Two forward and two reverse speeds are provided. Both lifting and traveling operations are powered electrically.

LIQUID COOLER

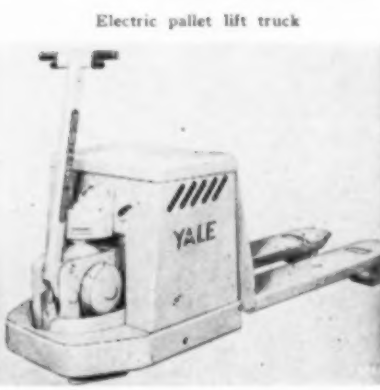
Close control in liquid cooling operations is claimed for a new industrial liquid cooler offered by Niagara Blower Co., 6 East 45th St., New York 17, N. Y. The method used is to spray the liquid over banks of coils in which the refrigerant is expanded. The liquid then falls into the tank and is recirculated independently of the distributing system, thereby gaining close control over temperature and efficiency of heat transfer, regardless of any intermittent use that may be made of the liquid. Examples of such in-

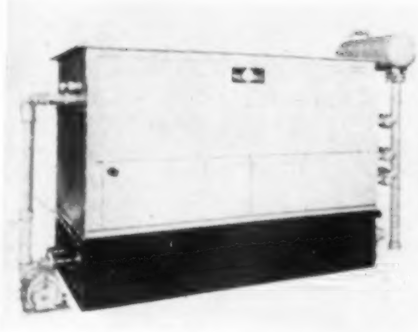
Improved quadruplicate screw pump



Adjustable portable belt conveyor

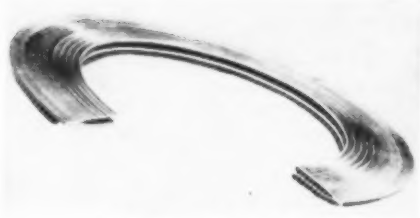
Electric pallet lift truck



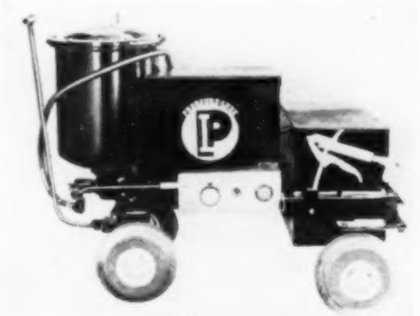


Industrial water cooler

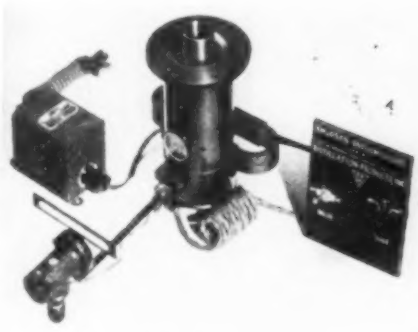
Pulsing motor control drive



Pressure-sealing gasket



Portable grease lubricator



Improved Knudsen vacuum gage

Flexible ventilating tubing

termittent use occur in air-conditioning and other processes where the circulated liquid may be used for process cooling. It is claimed to be possible to reduce water to a temperature of 33 deg. F. constantly without danger of damage from freezing. A special solution can be supplied for lower temperatures. Various capacities are available, ranging from 4.7 to 137 tons of refrigeration, with water delivery ranges from 11 to 220 g.p.m.

IMPROVED VACUUM GAGE

Continuous reading of pressures in the micron range is possible with an improved Knudsen gage recently announced by Distillation Products, Inc., Rochester 13, N. Y. The new gage is said to overcome all mechanical disadvantages which have previously prevented plant use of this type of gage in high vacuum installations. Ruggedness is obtained by any arrangement of damping magnets and the gage may be transported without disassembly. The gage operates by deflection of a vane which is proportional to the number of molecules striking it after being accelerated by a pair of heating coils. Gages of this type are not injured by accidental admission of atmospheric pressure.

FLEXIBLE TUBING

For portable or semi-permanent ventilation or the handling of air, gases, or light solids, the Spiratube Division of Warner Brothers Co., Bridgeport, Conn., has announced a new type of flexible tubing which is not collapsible under plus or minus pressures but is retractible to about one-eighth of its extended length. The fabric cover is spiral-stitched to the spring steel helix core in such a way that the inside surface is free of wire ridges and hence provides little resistance to air flow or the passage of solids.

PRESSURE-SEALED GASKET

Using the pressure within the line to produce a corresponding sealing pressure on the flange faces is the unusual accomplishment of a new gasket developed by Goetze Gasket & Packing Co., New Brunswick, N. J. As shown in the illustration, this is a serrated type gasket constructed like a bellows, which gives it its name of bellowseal. The two disks of iron, low carbon or stainless steel or Monel metal, are machined with standard serrations and welded together along their outer periphery to form a spring-like ring.

PORTABLE LUBRICATOR

Necessity for hand greasing operations is eliminated by a portable greasing unit, available either with a battery-powered or a gasoline-driven motor, that has been announced by Pressurelube, Inc., 609 West 134th St., New York 31, N. Y. The equipment can be supplied with a grease gun for any purpose, delivering up to 12,000 lb. of pressure which is said to clear the most obstinate channel stoppages.

MOTOR CONTROLLER

Known as the Pulsing Drive, a novel method of motor control has been announced by Yardeny Engineering Co., 105 Chambers St., New York 7, N. Y. This device provides single knob precision control for any type of reversible motor, both direction and extent of motor motion being under complete control of the single knob. The motor may be continuously rotated or moved in small increments. Slow clockwise rotation of the control knob produces corresponding motor motion in small increments, while reversing the knob produces the reverse effect. This permits accurate spotting. More rapid rotation of the control knob produces faster motor motion. By depressing the knob and turning it slightly to left or right, continuous forward or reverse motion can be accomplished.

EQUIPMENT BRIEFS

Extremely rapid automatic operation in measuring the concentration of elements in alloys is available in a direct-reading spectrometer developed by J. L. Saunderson and coworkers at the Dow Chemical Co., Midland, Mich. Used in the company's magnesium alloying plant, it secures alloy analyses in 40 seconds through the substitution of an electronic measuring method for determining the intensity of spectrum lines, rather than the usual photographic method. Up to 14 elements can be determined simultaneously. Girl operators can be trained to use the instrument efficiently in a single day.

For a variety of steam-cleaning operations, the D. C. Cooper Co., 20 East 18th St., Chicago 16, Ill., has developed a new automatic-generating type steam cleaner which is portable, raises steam in ten minutes, operates on low cost fuel oil and is said to be simple and economical to operate. Its low price is said to make it available for the smallest plant.

Pipes and cables underground may be located accurately by means of the Stewart Cable Tester and Locater announced by W. C. Dillon & Co., 5410 West Harrison St., Chicago 44, Ill. The device tells just where the cable or pipe is buried and just how deep, being particularly handy for locating old cable or pipe for which installation records have been lost or forgotten.

As an accessory, Towmotor Corp., 1226 East 152d St., Cleveland 10, Ohio, has developed an "up-ender" which is applicable to its standard fork truck. Although developed primarily for handling rolls in the paper industry, the device can be used for any handling operation requiring move-

ment of cylindrical loads in either vertical or horizontal position.

Model ELS is the designation of an improved Staynew filter for liquids, announced by the Dollinger Corp., Rochester 3, N. Y. This cylinder features a new design of filter insert said to be superior to older types. The insert assembly consists of inner and outer radial finned forms of wire cloth, with the filter medium crimped over the outer form which is then slipped over the inner form. Practically any crimpable sheet type filtering medium can be used.

Safety vents combining a rupture diaphragm and a vapor valve have been announced by J. A. Zurn Mfg. Co., Erie, Pa. The rupture disk will relieve excessive pressure, thus minimizing explosion hazard, but in addition the units include a special device with perforated brass flame barrier plates to permit the safe escape of flammable gases from the tank without flashback.

W. H. Wheeler, Inc., 234 East 46th St., New York 17, N. Y., has announced that the same general principles employed in household air fresheners may be used industrially, by means of the Airkem chlorophyll air freshener developed for odor control purposes. This material is applied to the air stream of an air conditioning system by means of an evaporator unit supplied by the manufacturer. It is claimed to be possible to neutralize objectionable odors, to create fresh air qualities indoors and to reduce fresh air requirements and conditioning system load.

As a means of eliminating static electricity in moving webs and machinery, United States Radium Corp., 535 Pearl St., New York 7, N. Y., has introduced an extremely thin metallic foil incorporating a radioactive substance and welded to a non-radioactive metal backing which, when placed in the region of an electrostatic charge, dissipates it through ionization of the surrounding air. The effectiveness of the device is said to be retained permanently.

Ram pacer for hydraulic tester

TEST PACER

To permit the application of loads at certain desired exact speeds in the testing of materials on tensile test machines, the Southwark Division of Baldwin-Southwark Locomotive Works, Philadelphia 42, Pa., has developed a device known as a Ram Pacer which attaches to a standard hydraulic testing machine, giving control over the crosshead movement at any of eight preset speeds from 0.1 to 1.0 in. per min. The unit is attached to the fixed frame of the machine while the dial portion of the apparatus is attached to the moving crosshead. The Pacer can also be used as a deflectometer, its dial indicating deflection of the specimen under test.

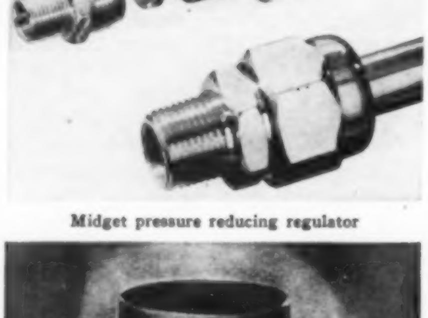
TUBING FITTING

No end preparation or soldering is necessary in use of the Flexigrip tubing fittings announced by Gustin-Bacon Mfg. Co., Kansas City, Mo. Available in standard sizes of $\frac{1}{8}$ to $1\frac{1}{2}$ in. O.D., the fittings consist, as shown in the accompanying view, of four parts, a body, gripping ring, synthetic rubber gasket and nut. Attachment is said to be simple and the resulting seal is claimed to be so flexible that it will withstand unusual vibration or impulse.

OXYGEN GENERATING MASK

Perfected in the early days of the war and immediately adopted for Navy use, the Chemox oxygen breathing apparatus of Mine Safety Appliances Co., Pittsburgh, Pa., is now available for civilian use. Employing a replaceable chemical canister, the apparatus gives the wearer a protection of 1 hour in unbreathable air, producing its own oxygen simply through the action of breathing into it. Exhaled air passes from the facepiece through an exhalation tube and into the canister where carbon dioxide is removed. Evolved oxygen flows into a breathing bag reservoir and then to the facepiece through an inhalation tube. The entire unit weighs $13\frac{1}{2}$ lb. and requires no cylinders, high pressure valves or fittings.

Flexigrip tube fitting



Midget pressure reducing regulator

MIDGET REGULATOR

For small high-pressure lines of $\frac{1}{8}$ and $\frac{1}{4}$ in. pipe size, the Grove Regulator Co., 6527 65th St., Oakland 8, Calif., has developed a pressure regulator weighing only 2 lb. which is available regularly for initial pressures to 3,500 lb. and in special models, to 5,000 lb. The range of control pressure is adjustable from 5 to 1,500 lb. Designed for air and gases, the diminutive unit can also be furnished for liquid service.

CURRENT INPUT CONTROLLER

Designed to provide extremely accurate control of electrically heated furnaces, a new electric type controller developed by the Bristol Co., Waterbury 91, Conn., combines a recorder and a proportional current-input controller in a single case. A rotating cam that interrupts the flow of current to the heating coil, so that the duration of heating is determined by the departure of the control temperature from the control point, is used to secure the advantages of proportioning control.

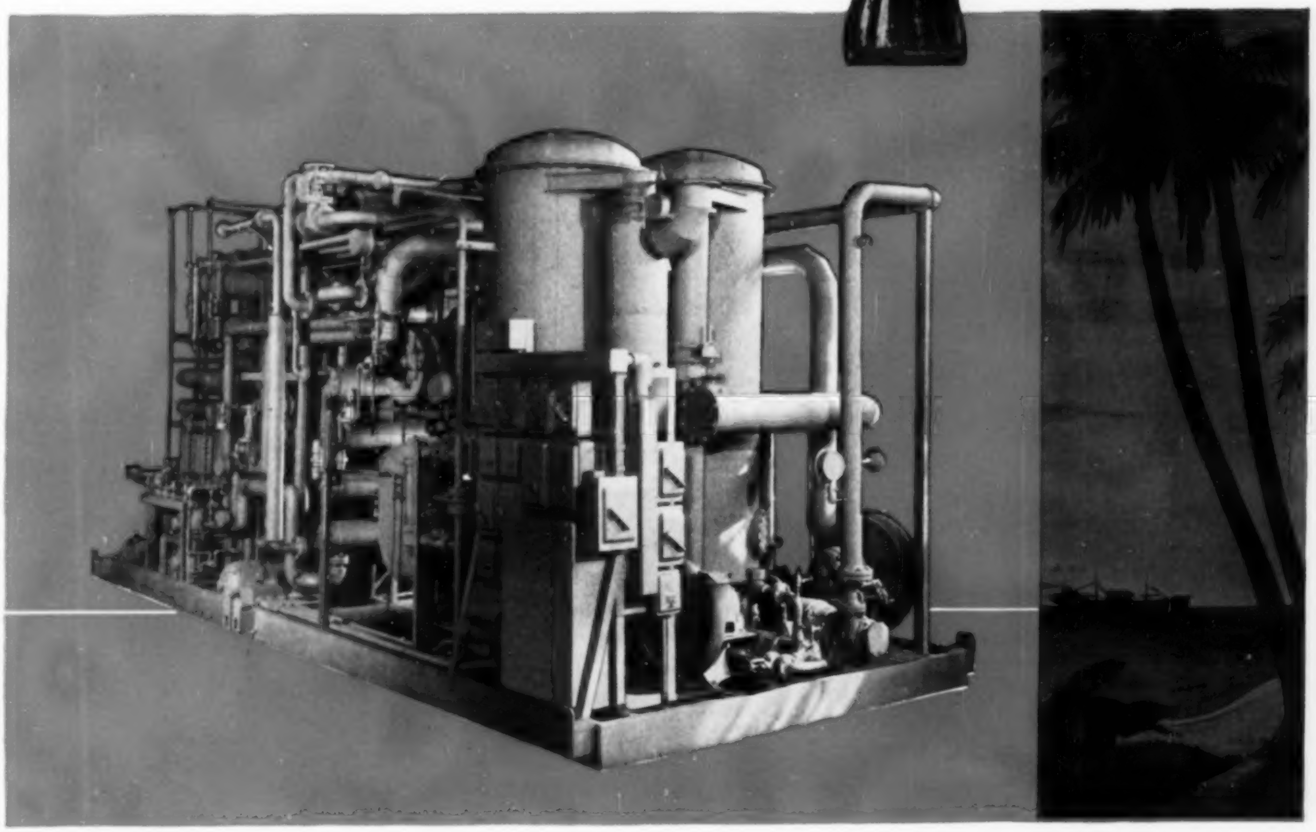
BAGGING SCALE

Recent improvement of its OK bagging scale has been announced by OK Scale Co., 1389 Niagara St., Buffalo 13, N. Y. This device fills and accurately weighs up to six 100-lb. bags per minute and is capable of handling burlap, cloth or paper bags up to 200 lb. capacity. The device is portable and may be used interchangeably on several different hoppers.

Current input-controller-recorder

Improved bagging scale

Behind *the global high-sign*



Girdler's global carbon dioxide plant

ORCHIDS to The Coca-Cola Company for an outstanding morale-building accomplishment in bringing the familiar COKE to Americans in so many far away places. We are proud of our contribution, in furnishing this "package" carbon dioxide plant, designed and constructed by Girdler for overseas duty with COCA-COLA.

Capable of producing 300 pounds of high-purity liquid carbon dioxide per hour, the plant is only 9 feet wide, 22 feet long, 11 feet high. It was shipped virtually intact, in two sections, ready for use upon arrival at any destination. It has been moved with the Armed Forces from place to place in the Far East and will probably be in Tokyo when you read these lines.

Portable and semi-portable plants of this type have been developed by Girdler in a number of standard designs and capacities.

Girdler offers processes for *gas manufacture, purification, separation, and dehydration.* Consult Girdler about your problems concerning *hydrogen sulphide, carbon monoxide, carbon dioxide, inert and controlled atmospheres, natural gas, refinery gases, liquid hydrocarbons, hydrogen, nitrogen.* Originators of the *Girbotol Process.*

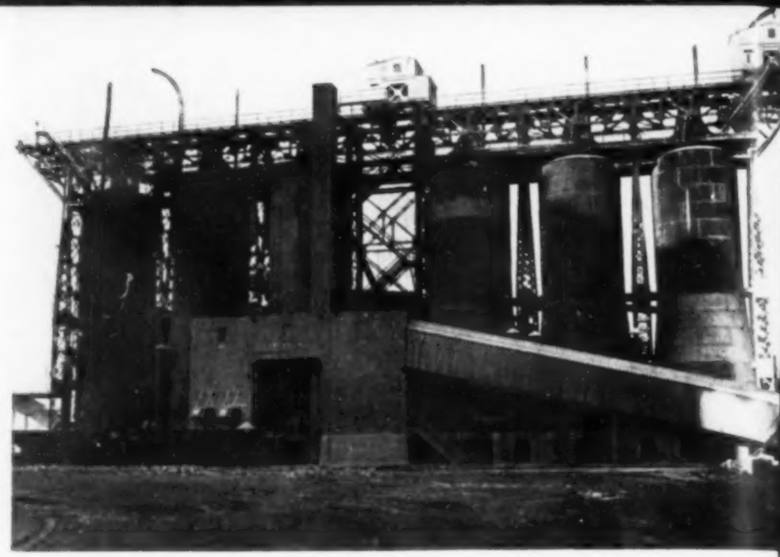
WE DON'T GUESS ABOUT GAS

CHEMICAL ENGINEERS AND CONSTRUCTORS

The GIRDLER CORPORATION

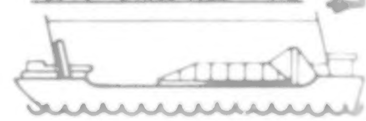
Gas Processes Division, Dept. CM-2, Louisville 1, Ky.
New York Office . . . 150 Broadway, New York 7, N. Y.

1 **Salt brine is obtained from wells at the company's plants at Wyandotte. North plant of company is shown**



2 **Limestone and coke are burned in kilns to form quicklime and carbon dioxide gas. Quicklime is later slaked to form milk of lime**

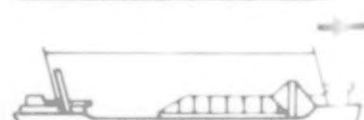
Wyandotte limestone quarries at Alpena, Mich.



One of the four company operated freighters

Salt is pumped from 1,400 ft. bel company property at Wyandotte

Company owned collieries in Curtisville



Company freighters transp both co and limestone to docks at Wyandott

INTEGRATED ALKALI INDUSTRY

At Wyandotte, Mich., the Wyandotte Chemicals Corp. has developed an integrated alkali industry. From company-owned limestone quarries, salt wells, and coal mines are derived the raw materials for the production of chlorine, caustic soda, calcium carbonate, calcium chloride, soda ash, sodium bicarbonate, and dry ice. The coke plant supplies coke to the lime kilns, ammonia for processing, and benzene, toluene, xylene, and derivatives to the list of products of the plant.

The lime kilns supply carbon dioxide to the dry ice plant and to the carbonator and recarbonator of the sodium bicarbonate plant. Part of the crude bicarbonate formed in the carbonator passes to the soda ash building where it becomes the raw material. Some of the sodium carbonate from the soda ash plant goes to the calcium carbonate plant where it is reacted with calcium chloride to form various grades of precipitated calcium carbonate. Another portion of the sodium carbonate is used in the causticizers with milk of lime to form caustic soda which is conveyed to the caustic soda plant.

Lime, the other product of the kilns, is slaked and then used in the causticizing operation just mentioned and also in the ammonia stills to react with the ammonium chloride to form ammonium hydroxide.

Brine is principally used in the electrolytic cells for making chlorine and caustic soda. The former is dried and liquefied for the market. The latter goes to the caustic finishing plant. Here it is combined with caustic produced in the causticizer of the calcium carbonate plant.

Other brine from the wells is purified and pumped to the absorber in which it is mixed with ammonia from the ammonia stills and the byproduct plant to form ammoniated brine. This is used in the carbonator of the bicarbonate plant.

The accompanying illustrations are from photographs taken in the plants of the Wyandotte Chemicals Corp.

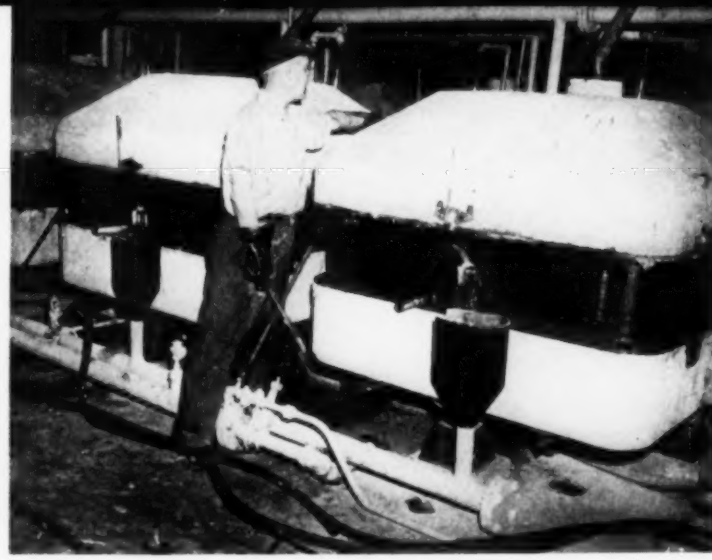
CHEMICAL & METALLURGICAL ENGINEERING

February, 1946

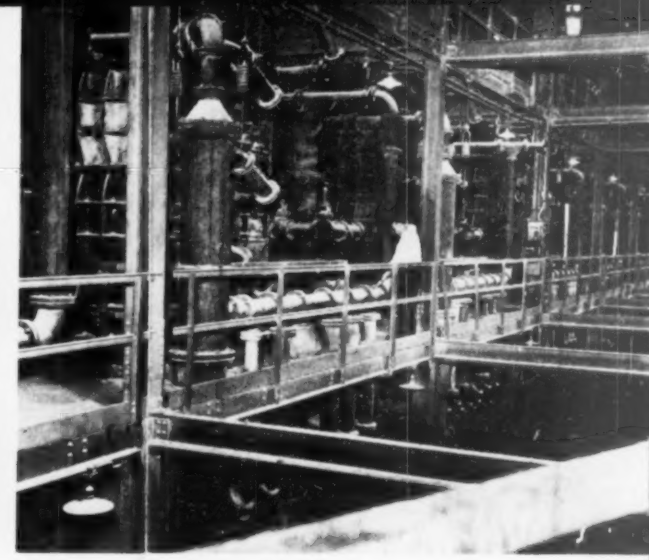
PAGES 172 TO 175

A Chem & Met PICTURED FLOWSHEET

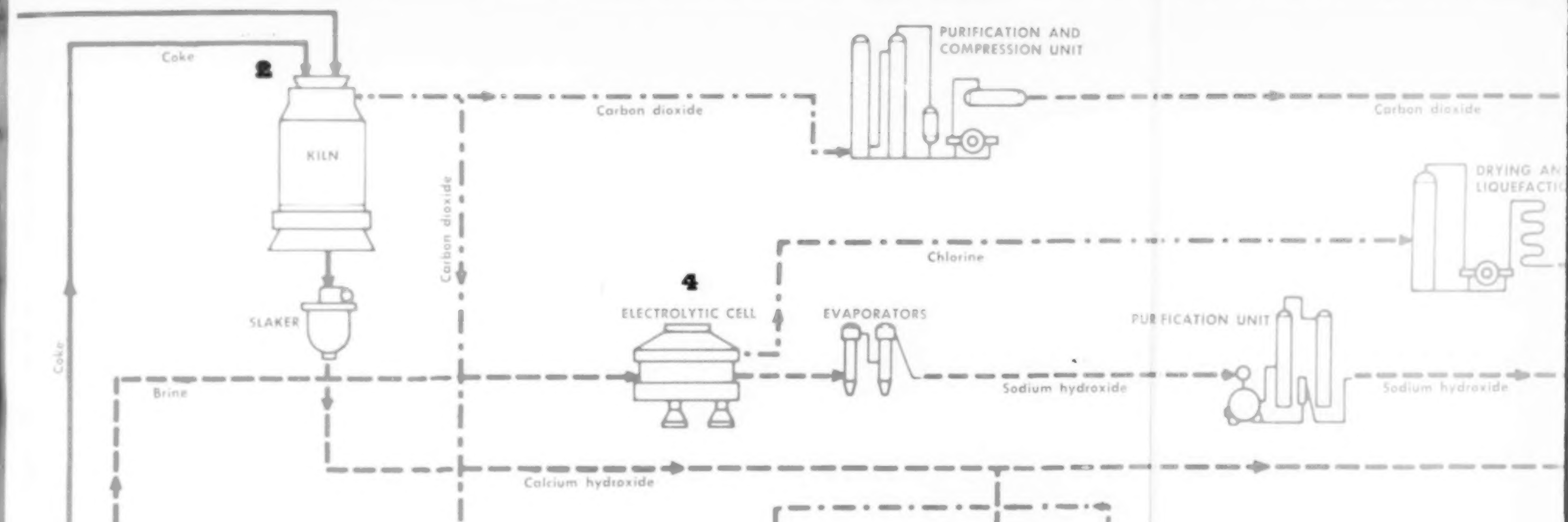
3 Liquid carbon dioxide expands to form "snow" which is compressed

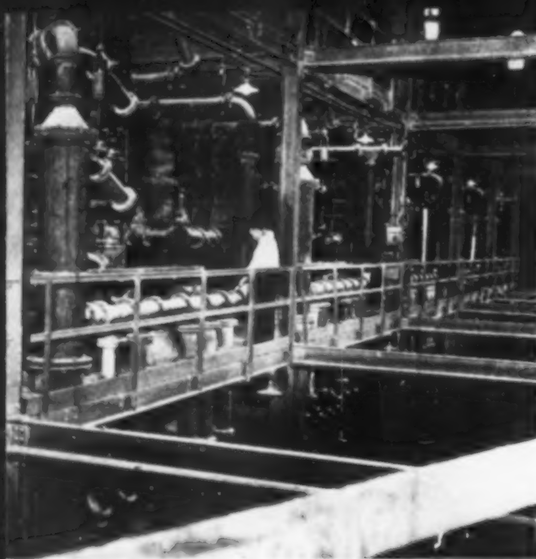


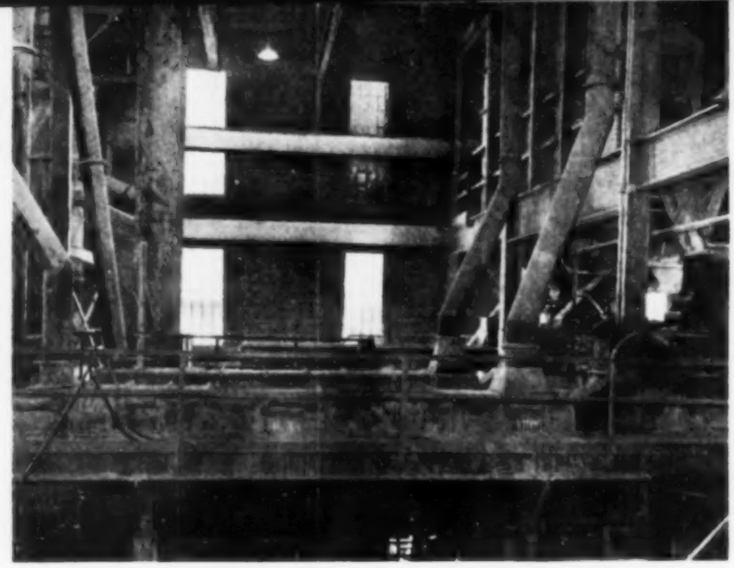
4 Brine from the company's nearby wells is separated into chlorine and caustic in several batteries of electrolytic cells

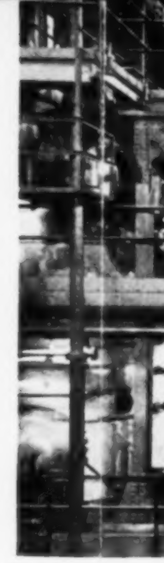


5 Ammonium chloride and milk of lime form calci[um] chloride and NH_4OH which is decomposed in ammonia st[ill]





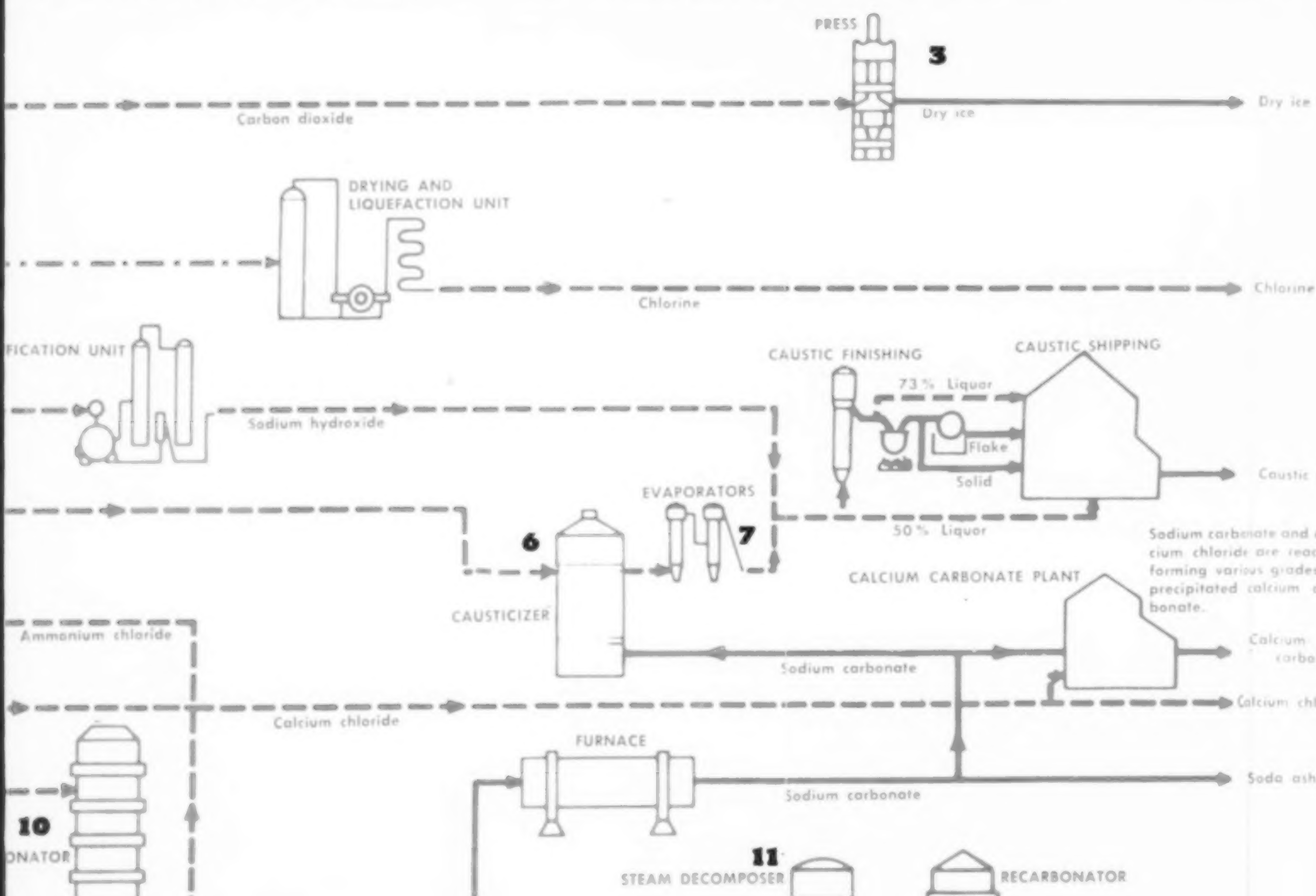


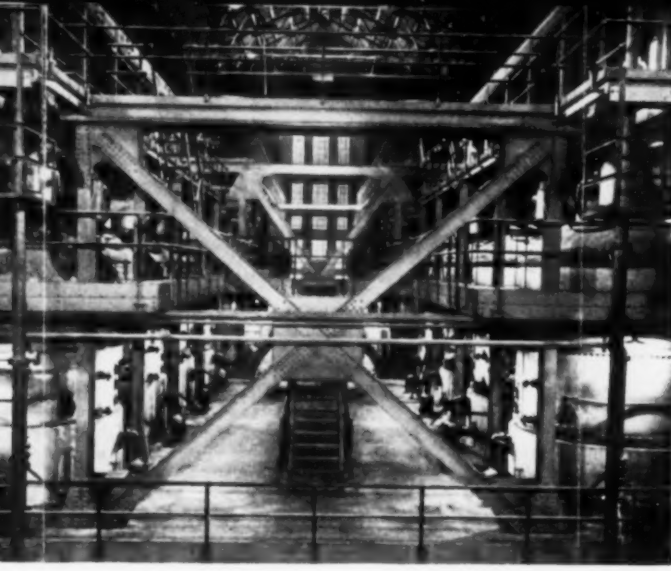


...m chloride and milk of lime form calcium ...d NH_4OH which is decomposed in ammonia still

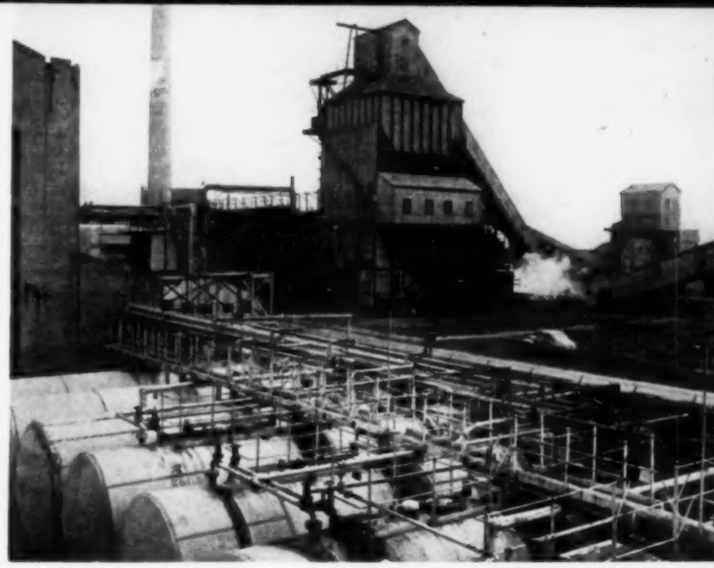
6 Milk of lime and sodium carbonate are reacted in causticizer to form weak caustic and a sludge of calcium carbonate

7 Caustic soda ... concentrated in ...





Caustic soda from the cell plant and from the causticizer is [...]centrated in these multiple-effect evaporators



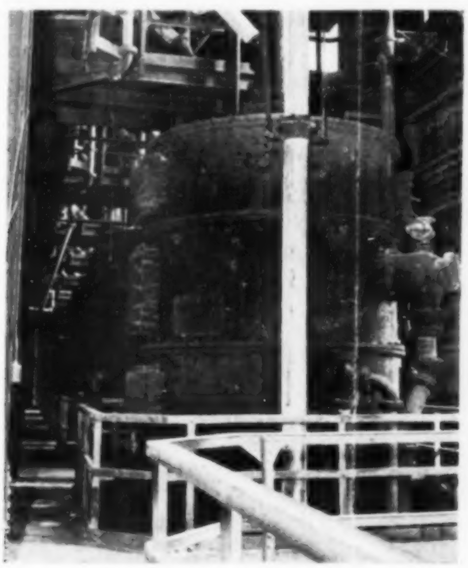
8 Coke plant produces coke for the lime kilns, ammonia for the process, and light oils and tar

Dry ice

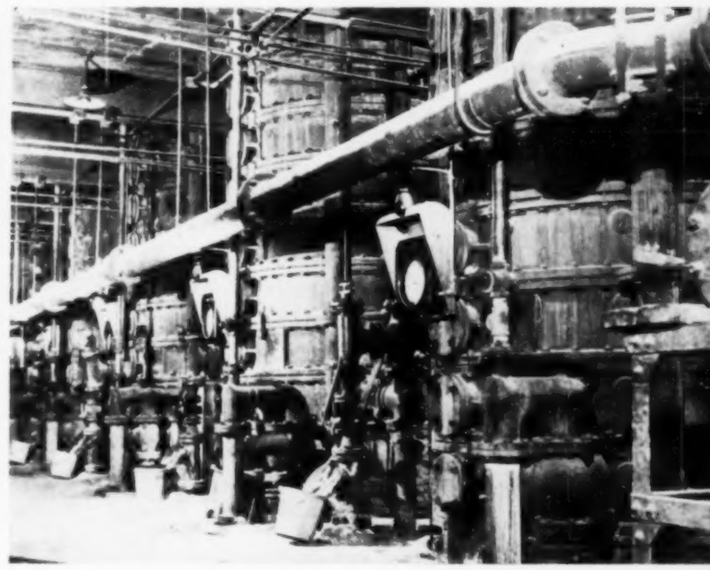
Chlorine

Caustic soda

[...]arbonate and cal[...]oride are reacted [...]various grades of [...]ted calcium car-



9 Brine flows countercurrent to gas flow in absorber to scrub gases containing ammonia



10 In the carbonator, calcium dioxide is bubbled through ammoniated brine forming ammonium chloride

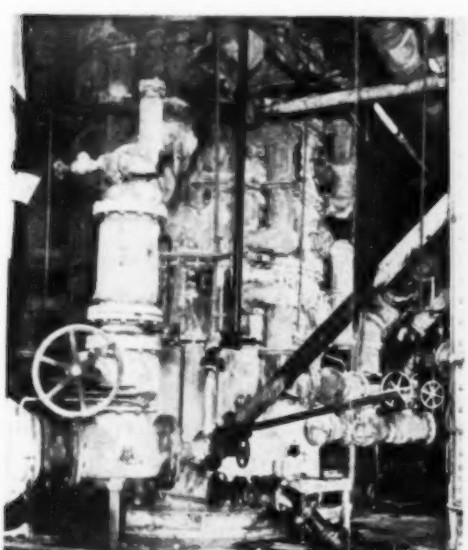
Calcium carbonate

Calcium chloride

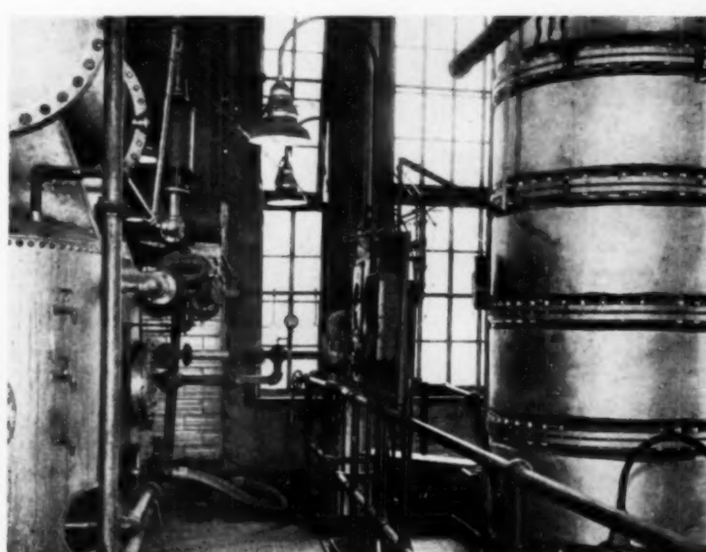
Soda ash

Sodium bicarbonate

Benzene, Toluene, Xylene and derivatives



11 Crude bicarbonate is heated in steam decomposers to form a carbonate solution



12 Benzol, toluol and xylol are separated and refined in fractionating columns of the byproduct coke plant

A NEW SERVICE! FOR CHEMICAL ENGINEERS

SEND US YOUR JOB CONDITIONS

We'll send you the information promptly

Consult America's foremost proportioning specialists . . . without obligation. The experience gained in over 20,000 installations is at your service. We can tell you all about the layout and installation of chemical proportioning equipment for automatically treating, blending, diluting and sampling in process operations . . . %Proportioneers% provide accurate control of end products through modern, continuous, "streamline" processing.

Send details today for the complete analysis of your specific problem.

SEE OUR EXHIBIT AT BOOTHS 477-479, 20TH EXPOSITION OF CHEMICAL INDUSTRIES

% PROPORTIONEERS, INC. %

Write %Proportioneers, Inc.%, 29 Codding St., Providence 1, Rhode Island.
Technical service representatives in principal cities of the United States, Canada and Mexico.

NEW PRODUCTS AND MATERIALS

R. W. PORTER, Assistant Editor

LACQUER RESIN

PRINCIPALLY for use in lacquers, Cellolyn 102, a rosin base resin, is now available from Hercules Powder Co., Wilmington, Del. This new resin may be used in place of rosin maleates with certain advantages and is claimed to be suitable as a resinous component of nitrocellulose lacquers for a wide range of industrial uses as well as for furniture lacquer finishing systems and in lacquer primer surfaces. Nitrocellulose lacquer films containing this new resin have better cold check resistant qualities than rosin maleate nitrocellulose lacquer films with no sacrifice in print resistance or hardness of film.

MOLD LUBRICANTS

TWO MORE special silicone products, DC mold release fluid and DC 7 compound, have been recently announced by the Dow Corning Corp., Midland, Mich. These new materials serve as lubricants which reduce the friction between dies and plastic materials, improve plastic flow, reduce surface striation and afford easy release from the mold or from the rubber bags used in low pressure laminating. The value of these two compounds results from their largely inorganic nature since this makes them incompatible with almost all types of organic plastics and rubber. They adhere preferentially to metal and do not vaporize, carbonize or change appreciably in consistency at molding temperatures.

ENAMEL REMOVER

SYNTHETIC enamels may be removed cleanly by the wrinkling action of Enthone enamel stripper S-300, according to the Enthone Co., New Haven 2, Conn. This new enamel stripper is said to effectively remove alkyds, malamines, and urea-formaldehyde coatings, with no damage to the base metal. Phosphate coatings and anodized coatings are unharmed by this stripper which is used at full strength at room temperature.

SILVER BRAZING FLUX

RECENTLY placed on the market by Sherman & Co., New York, N. Y., a silver brazing flux melts and forms a protective coating over surfaces at 480 deg. F., well below the oxidation temperatures of most metals. Known as "Nu-Braze" Wonderflux No. 4, this material has a pH of 5 to 6 and can be painted on parts and allowed to remain for long periods without producing corrosion. It contains no free chlorides and does not release objectionable volumes of noxious fumes as do many similar fluxes. At 800 deg. F. this material is said to be water thin, capable of flowing through clearances as close as 0.001 in. After melting it hardens to an extremely brittle glass-like scale which can be removed easily with either hot or cold water or may be jarred off.

CONTENTS

STAINPROOF WALL COVERING

AFTER UNDERGOING field tests for several months a new stainproof wall covering will be available in July 1946, according to its manufacturer. Known as Varlon, this new wall covering will be marketed by Varlon, Inc., a division of United Wallpaper, Inc., Chicago, Ill. Various types of dirt, grease or stain may be removed from Varlon by the simple application of soap and water. It has withstood severe wear and tear in numerous public places such as government office buildings, restaurants, theatres, hotels, etc., and tests have shown that heretofore indelible stains, such as lipstick, hot grease, crayon and ink, may be easily washed off.

WETTING AGENT

DEVELOPED by the Naylee Chemical Co., Philadelphia, Pa., a new wetting agent known as Naybasol, is now commercially available. This wetting agent has been tested extensively in the processing of textile fibers and fabrics, synthetic latices and plastics, leather, paper, pulp and water paints. Other miscellaneous uses may be found in the processing of ceramics, in the manufacture of cleansing and shampooing liquids and other similar types of applications.

PARAFFIN MODIFIER

DEVELOPED and used before the war, Tervan, an additive to improve the properties of paraffin, is now commercially available from the Standard Oil Co. (N. J.), New York, N. Y. Consisting of a concentrated blend of paraffin wax and polybutene, this material is produced in three main grades which range from a viscous, sticky semi-liquid to a tough, dry, elastic grade similar to crepe rubber in appearance. These are designated as Tervan 3315, 349 and 449. They are compatible with paraffin wax in all proportions and with many of the other additives commonly blended with wax coatings.

Addition of Tervan to paraffin imparts properties of greater flexibility and adhesion, and permits chipping, scuffing and flaking of the wax on such papers as bread wrap. Its main use is in coating papers for food packages. Other uses include its application in asphalt-coated and laminated papers, where it lowers viscosity permitting easier coating and improving moisture impermeability.

PLASTER IMPREGNANT

USED TO treat low cost plaster castings, Plastiglaze, developed by Duorite Plastic Industries, Culver City, Calif., is claimed to improve the appearance and durability of plaster castings. This new material is an air setting resin produced by combining various thermoplastic and thermosetting resins in the presence of any one of several solvents.

By immersing the casting in this new resin for a half hour and then air drying at room temperatures for about four hours, the casting becomes strong enough to be dropped on the floor without breakage and may be immersed in solutions of water and acid for several days without deterioration. Plastiglaze may be used to strengthen and to improve the appearance of other porous materials such as wood and cardboard.

SYNTHETIC TANNIN

THE CHESTNUT tree which has been the chief source of sole leather tanning agents for centuries has been almost wiped out in this country due to the chestnut tree blight which has killed most of the trees in the country. Because of the impending shortage of natural tannin, the Monsanto Chemical Co., St. Louis, Mo., in cooperation with several other organizations, has developed a synthetic tanning chemical believed to be superior to the natural product. Identified as Exan, this new tanning agent is said to impart to sole leather a fine smooth grain as well as such desirable qualities as tightness, firmness, pliability and resistance to abrasion, water and wear. Wide uses in tanning operations, particularly for retanning chrome tanned shoe leather, are foreseen for Exan. This material permits the

production of light colored and lightfast leathers and makes possible greater speed of tanning. It is now available in commercial quantities.

FUNGICIDE

A LIQUID formulation for use as an insecticide or as a fungicide on certain orchard crops, small fruits, etc., has been announced by the E. I. du Pont de Nemours & Co., Wilmington, Del. Consisting of a water-soluble dinitro dormant spray containing sodium dinitro-ortho-cresylate as its active ingredient, Krenite as it is known, is said to be effective during the period when the plants are dormant. This compound must be dissolved in water and applied to plants or trees early in the spring before any appreciable amount of green tissue shows.

ANTI WELD-SPATTER

FORMULATED for use in welding processes wherever weld-spatter is undesirable and must be avoided, two new compounds are now available from the Electric Welding Div. of the General Electric Co. Furnished in powder form, ready for mixing with water, these compounds are identical in performance and are claimed to completely prevent spattering. No. 9951 is non-adherent and can be readily removed with an air hose or a dry cloth, while No. 9952 is semi-adherent but can be quickly and easily removed with a damp cloth or a direct stream of water. Either of these counpounds will adequately cover 450 to 750 sq.ft. of work depending upon the thickness of the film used. The compounds are completely inert and cannot burn, thus being completely smokeless.

HIGH TEMPERATURE CERAMIC COATING

DEVELOPMENT of a ceramic coating capable of withstanding the high exhaust temperatures of aircraft and other military internal combustion engines has recently been announced by the U. S. Bureau of Standards. The project was undertaken to find a substitute for stainless steels when such alloys became scarce during the war. The use of certain quantities of calcined aluminum oxide in a slight modification of conventional practice produces an enamel that protects steel exhaust systems from damage. The material is applied in thin coats of 0.002 to 0.003 in. at 1,600 deg. F. Considerable experimentation has shown that the new enamel has been entirely satisfactory wherever employed. Manufacturers are investigating the material as a means of protecting other high temperature surfaces.

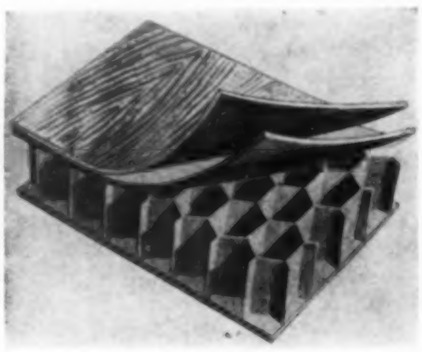
SEALING COMPOUND

RECENTLY announced by Parker Appliance Co., Cleveland, Ohio, a general purpose thread and gasket sealing compound is expected to be useful in the assembly of threaded fittings and in piping work. This new organic compound under the brand name of Uniseal is claimed to produce a high efficiency seal which is proof against air, water, steam, gas, gasoline, oil and various solvents. Tests have shown it to be virtually insoluble in benzene, xylene, carbon bisulphide, ketones, and the aromatic aviation fuels.

Uniseal is a paste containing no free metallic particles or any additives which might wash out. It flows smoothly to form ribbon gaskets, and blends readily with cut gasket material. This compound possesses good anti-seize characteristics and facilitates dis-assembly and rearrangement of work since the seal breaks cleanly with a minimum of force.

LIGHTWEIGHT LAMINATE

A NEW lightweight structural material consisting of a honeycomb of phenolic-resin impregnated fabric sandwiched between and firmly bonded to thin sheets of aluminum, stainless steel, wood veneer or plastic, has been developed by the United States Plywood Corp., New York, N. Y. and the Glenn L. Martin Co., Baltimore, Md. The honeycomb may be of paper, cotton cloth, fiberglas or linen, impregnated with a phenolic-resin before the core is formed. Both weight of the core material used and the type of facing will vary with the load requirements of the finished material. A number of applications are envisioned for this material such as walls, ceilings and partitions in railroad passenger cars, and other places where lightweight materials are desirable. Edges of the honeycomb sheets are readily sealed against moisture and the material does not warp. It can be made in sheets as large as 7x30 ft. with the core as thin as ⅛ in. and as light as 4 lb. per cu.ft.



Laminated structural material

PLYWOOD RESINS

A PRECATALYZED urea-formaldehyde resin for hot pressed plywood has recently been announced by the Resinous Products & Chemical Co., Philadelphia, Pa. Designated as Uformite 501, this new resin permits high extension with flour and thus provides a low cost material comparable to soybean and vegetable glue. Uformite 501 is water resistant and insures an accurate and adequate catalyst ratio with a one component adhesive. This resin is a tan colored, free flowing powder and is readily dispersible in water and produces a cured film with a pH of 4.0 or higher. Catalyst content assures adequate cure in both unextended and highly extended hot pressing mixtures.

FILM EMULSION

IT IS NOW possible to print photographic negatives in odd and unusual places by use of a new jellylike emulsion which can be spread on many kinds of materials, sensitizing them for photographic print use. After printing, the metal, wood or plastic prints are developed in the same manner as any commercial photo paper. The new emulsion, developed by the Glenn L. Martin Co., Baltimore, Md., is a thin jellylike substance which when heated to a temperature of 125 deg. F., becomes a liquid applicable to the desired surface with a brush, sponge or soft cloth. Allowed to dry, the negative is then printed on the sensitized surface and the development proceeds normally as if it were a commercial paper.

This new emulsion may find use in industries where reproduction of drawings for manufactured products may be desired. Such drawings can be either made in full scale for ease in reading and checking during manufacturing processes or can be reduced, if small prints are desired. Proportions remain exact and the need for redrawing to a different size with the possibility of error is eliminated.

WATER MIX ENAMEL

AN OIL base enamel which uses water as a thinning medium will be available this spring from the Glidden Co., Cleveland, Ohio. Marketed under the brand name of Spred-Luster, this material has undergone exhaustive tests and is claimed to dry to a hard satinlike finish and wash readily, thus making it applicable to practically all types of rooms including those which must be washed frequently. Spred-Luster may be rapidly and easily applied, its quick drying properties (about 2 hr.) make it valuable where the time required to repaint and re-occupy a room is of importance.

This new paint is primarily for use on walls and ceilings, but may be used equally as well for finishing doors, baseboards and moldings. It is said to be comparable in appearance and wearing qualities to many prewar gloss finishes. This new enamel will be available in a number of desirable colors.

PLASTICIZER

A LOW COST primary plasticizer for use with buna N rubber has been developed by the Emery Industries, Inc., Cincinnati, Ohio. This new material is now available for commercial use under the brand name of Plastolein X-348. It is said to have excellent aging characteristics with low heat loss and is said to be high in tensile strength, elasticity and recovery. Since it is oil insoluble, mixes containing Plastolein X-348 do not shrink in oil. While it is recommended especially for buna N and vinyl buna N mixes, it is also claimed to be compatible with nitrocellulose, ethyl cellulose and other similar materials.

TEXTILE SOFTENER

A NEW TEXTILE SOFTENER, Aerotex Softener H, has recently been announced by the Textile Resin Department of the American Cyanamid Co., Bound Brook, N. J. Regardless of any other chemical treatment this softener makes it possible to control almost completely the smoothness and suppleness of various types of fabrics. It may be used on rayons, cottons and wools and is well adapted for use with all types of blends. It is said to be superior to most synthetic softeners since it has less tendency to affect light-

fastness properties of direct and developed colors. It does not have any tendency to discolor white materials but offers good resistance to washing and dry cleaning. Since Aerotex Softener H is a wetting agent in itself, it may be used to serve a dual purpose. It is said to have value when used in a resin impregnation bath to reduce the bleeding of certain dyestuffs during impregnation. Aerotex Softener H is composed of colloidal components blended in alkaline solution and may be readily dispersed in warm water by ordinary stirring. It does not affect finishes designed for shrinkage, stretching and crease proofing control.

LAMINATING PLASTICS

CLAIMED to possess a number of properties and characteristics heretofore unobtainable, a new family of laminating plastics known as the C-5 resins has been announced by the Bakelite Corp., New York, N. Y. The first of these, designated as Bakelite C-5 laminating resin X-J-17694, consists of a surfacing material for decorative laminates. This new material is a xylene-toluene solution containing about 50 percent resin. It is rated No. 10 on the Gardner color scale and has a viscosity of 15 to 18 centipoises, with a specific gravity of approximately 1.0 and a flash point of 45 deg. F. It weighs 8.3 lb. per gal.

A number of applications are suggested for this new material including the surfacing of rigid structures such as table tops and wallboards which have cores of phenolic plywood or asbestos fiber. The flexibility characteristics of these resins suggest their use for shaped articles such as wallboard moldings, instrument cases, etc. Practically all colors are obtainable and this resin imparts a high gloss and lustrous surface. Surfaces imparted to the laminate by this material are highly scratch and scar resistant and are also said to be resistant to organic solvents, soap solutions, citric and other fruit acids. In applying X-J-17694 resin, a variety of methods may be used. Temperatures and pressures may be selected within fairly wide limits.

ANTI-MALARIAL

DESIGNATED as SN 7618, a new synthetic drug has been developed for use in the treatment of malaria according to the Board for the Coordination of Malarial Studies, a branch of the Office of Scientific Research and Development. This material, 7-chloro-4-(4-diethylamino-1-methylbutylamino) quinoline, is said to be superior to both quinine and atabrine in that it relieves malaria more rapidly while producing fewer ill effects. It is claimed to be effective when administered only once a week as against the daily dosage required for atabrine and will relieve acute attacks in one to two days. SN 7618 does not stain or discolor the skin nor does it produce gastro-intestinal irritation.

CORE SAND BINDER

THE VERSATILE urea-formaldehyde resins are now adaptable to binding core sand used in casting such metals as aluminum and magnesium. Developed by the Resinous Products Chemical Co., Philadelphia, Pa., this synthetic resin binder, known as Uformite 580, is said to have many desirable qualities not found in conventional thermosetting resins. Its use requires no departure from standard foundry procedures but the resultant resin-bonded sand core permits the casting of complicated members which meet rigid requirements on tolerance and conformance to casting dimensions as well as strength and quality.

This new resin binder is a dust-free, water dispersible powder and may be added directly to the conventional muller, kneader or paddle-type mixers where it is uniformly dispersed throughout the sand without special precautions. It decomposes at the pouring temperature of aluminum and magnesium more rapidly than do drying oils. Thus, cores bonded with Uformite 580 break down readily during contraction of the metal on cooling and solidification, thereby facilitating core removal from the narrow constricted openings of the casting.

Its use in sand mixes is said to relieve any tendency to stick to core boxes, conveyors and blower equipment. Core sand mixed with this resin may be stored prior to baking as long as four to five hours without loss in tensile strength or surface hardness.

Uformite 580 cures by condensation rather than oxidation, and develops maximum binding strength in a shorter time under less drastic conditions than a drying oil.

RUST REMOVER

A NON-CORROSIVE rust remover, which is said to dissolve rust scale rapidly and remove it completely, is relatively non-corrosive to steel even under conditions of long exposure. Now commercially available, Nox-Rust, manufactured by the Nox-Rust Chemical Corp., Chicago, Ill., has been used to remove rust from precision bearings and machined surfaces without affecting critical dimensions. Ordinary rust removal takes only a matter of seconds, leaving no preceptible etching or discoloration of surfaces. It may be applied by the usual methods such as brush, spray and dip, but its long life and rapid action in otherwise inaccessible crevices makes dipping the most economical method.

SYNTHETIC ADHESIVE

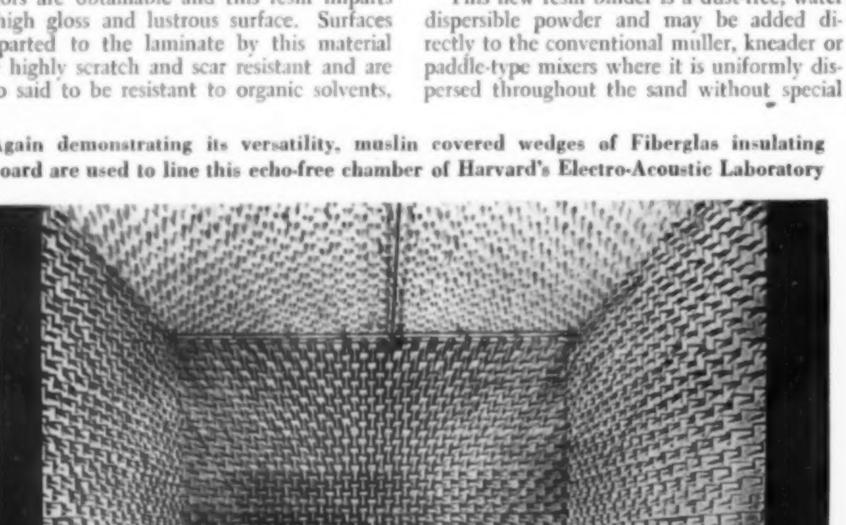
ORIGINALLY developed as an adhesive for special paper and fiberboard fabrications for the Army in connection with overseas shipments of ammunition, Flexbond, a new synthetic adhesive manufactured by the Special Chemicals Co., Cleveland, Ohio is now available for various paper industries including book-binding, padding and tabbing. When used in book-binding it exhibits unusual fast-setting properties imparting permanent flexibility. It does not settle, ferment or spoil, and is available as a milk white emulsion. It may be colored for special applications.

RADIOACTIVE CARBON OFFERS NEW PROMISE

FIRST laboratory experiments with long-lived radioactive carbon, bringing man closer to an understanding of photosynthesis and providing new techniques for the study of metabolism, have been announced by University of California scientists at Berkeley.

The researchers succeeded in labeling all of the groups of atoms of acetic and butyric acid with long-lived radioactive carbon. Previously it had been possible to impregnate only the simplest of molecules with short-lived radioactive carbon, which is useful for only four to five hours. Recent experiments indicate that it will be possible in the future to label many organic compounds in more than one way. The University of California scientists are Dr. H. A. Barker, associate professor of soil microbiology; Dr. Martin Kamen, formerly in the Radiation laboratory; and Victoria Haas, graduate student.

Again demonstrating its versatility, muslin covered wedges of Fiberglas insulating board are used to line this echo-free chamber of Harvard's Electro-Acoustic Laboratory



CHEMICAL ENGINEERING NEWS

AIR SHIPMENT OF FLAMMABLE MATERIALS UNDER STUDY

Foreseeing increased demands for air shipment of flammable materials and gases, provision has been made by the scheduled air lines to investigate the feasibility of flying various types of these commodities. The study will be made by the Shippers' Research Division, recently formed by the 24 United States flag airlines comprising the Air Transport Association of America, for the purpose of studying and preparing regulations dealing with the safe movement of hazardous items by air carriers.

The first class of materials to be probed will be flammable liquids. Such considerations as lowering a flash point with altitude, significance of explosive limits, spontaneous ignition temperatures, vapor pressure and other points never have been evaluated, and therefore a study of these properties as they affect safe air transportation is felt to be necessary.

Since present Civil Air Regulations permit the carriage of highly dangerous compressed gases such as hydrogen, butane, chlorine and sulphur dioxide, there is a need for careful study of present requirements for cylinders viewed in the light of the type of handling and conditions which they will encounter when transported by air. The project will involve a complete program of analysis and testing of present packaging regulations and will require studies directed toward the setting up of specifications in all cases where the material in question is considered to be improperly packaged under existing regulations.

TECHNICAL EXPERTS OF CWS HONORED FOR WAR SERVICES

Last month the War Department presented Certificates of Appreciation to 17 leading technical experts who served as Chemical Warfare Service consultants and members of an industrial intelligence team in surveying German chemical plants manufacturing military chemicals.

The certificates were awarded to the following: William S. Calcott, E. I. du Pont de Nemours & Co., Inc.; Francis J. Curtis, vice president in charge of research, Monsanto Chemical Co.; Gaston F. DuBois, formerly vice president of Monsanto Chemical Co.; Mayor F. Fogler, vice president, The Solvay Process Co.; John M. Harris, Jr., Allied Chemical & Dye Corp.; John W. Haught, E. I. du Pont de Nemours & Co., Inc.; Wilhelm Hirschkind, The Dow Chemical Co.; Jean G. Kern, Allied Chemical & Dye Corp.; Percy J. Leaper, Allied Chemical & Dye Corp.; Ford R. Lowdermilk, Allied Chemical & Dye Corp.; R. Lindley Murray, vice president in charge of research and development, Hooker Electrochemical Co.; Earl T. Nilsson, The Solvay Process Co.; Roy W. Sudhoff, Monsanto Chemical Co.; Ernest H. Volwiler, vice president in charge of research, Abbott Laboratories; Lester M. White, director of research, electrochemical department, E. I. du Pont de Nemours & Co., Inc.; Guy B. Panero, Todd & Brown Inc.; Lawrence C. Turnock, consulting engineer.

Those honored were members of the group assembled by the Chemical Warfare Service and dispatched to Europe prior to the fall of Germany. They moved forward with advancing troops and surveyed captured chemical plants, uncovering many new developments of military interest and accumulated a vast amount of technical information that may prove of value to the American chemical industry.

Complete reports covering their exploitations were transmitted to a special staff at the Department of Commerce for release to industry. Today more than 400 reports covering new developments in the German chemical industry have been submitted by the Chemical Warfare Service to the Department of Commerce for the information of American industry.

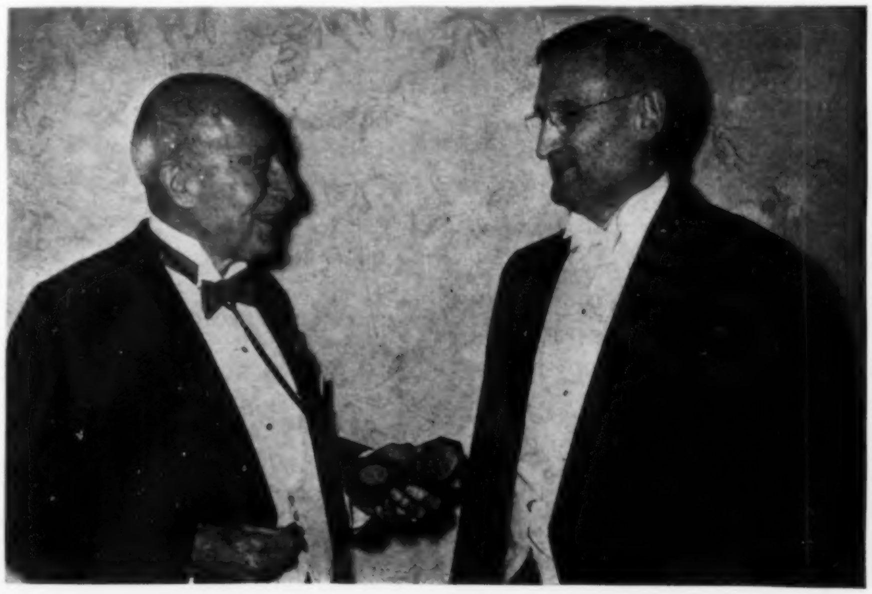
PLASTICS MANUFACTURERS ELECT OFFICERS

At its annual meeting held in New York on January 10, the Plastic Materials Manufacturers Association, Inc., re-elected as president W. Stuart Landes, vice president of Celanese Corp. of America. John R. Hoover, vice president of B. F. Goodrich Chemical Co. was re-elected to the office of vice president. Frank H. Carman was re-elected general manager and John E. Walker, secretary-treasurer with headquarters in Washington. A seven man board of directors also was selected. This includes Mr. Landes and Mr. Hoover and two directors held over from the 1945 board, James L. Rodgers, Jr., vice president of Libby-Owens-Ford Glass Co., Toledo, and Dr. D. S. Frederick, vice president of Rohm & Haas Co., Philadelphia. New members of the board are Harry Krehbiel, president of Catalin Corp.; M. G. Milliken, vice president of Hercules Powder Co.; and Felix N. Williams, vice president of Monsanto Chemical Co.

TWENTIETH EXPOSITION OF CHEMICAL INDUSTRIES

Plans have been completed and the doors of Grand Central Palace, New York, will be thrown open at 2 p.m. on Monday, February 25 for the Twentieth Exposition of Chemical Industries. The exposition will continue each day throughout the week from 11 a.m. to 10 p.m. with the exception of March 2 when it will terminate at 6 p.m. The general forecast indicates representation, often by two or more exhibits, in practically all the categories of previous expositions. Some exhibitors are handicapped by the limited amount of space available and will utilize scale models and special animated displays

Dr. Francis C. Frary, director of research, Aluminum Co. of America (right), being awarded the Perkin Medal at a dinner in the Hotel Commodore, New York, January 11, in recognition of his accomplishments in the field of industrial research. The award is made annually for distinguished service to the chemical industry by the American Section of the Society of Chemical Industry, the American Chemical Society, the American Institute of Chemical Engineers, the Electrochemical Society, and the Societe de Chimie Industrielle. The presentation was made by Dr. Marston T. Bogert, emeritus professor of chemistry, Columbia University (left).



as effective aids to visualization. The exhibitors list totals approximately 375 names subject to final adjustment of space requirements.

All visitors will be registered at the door upon presentation of invitations or credentials showing professional or business connections entitling them to the privileges of the floor. The general public will be excluded. There will be no admission fee and no charge for registration.

JUNIOR CHEMICAL ENGINEERS TO HOLD STUDENT BANQUET

On Thursday evening, February 28, the Junior Chemical Engineers of New York will hold their first postwar Student Banquet. Guest speaker will be R. P. Russell, president of Standard Oil Development Co., who will outline the outstanding technical advances made by the German oil and chemical industries during the war. S. D. Kirkpatrick, editor of *Chemical & Metallurgical Engineering*, will act as toastmaster.

The Student Banquet is a regular affair, timed to coincide with the Exposition of Chemical Industries and designed to give chemical engineering students from nearby colleges an opportunity to get acquainted with some of the younger members of their profession. It also is expected that the prominence of this year's participants will attract many members of the American Institute of Chemical Engineers, who will be in New York to attend the institute's regional meeting. Mr. Russell spent several months in Germany as head of the Chemical, Oil and Rubber Division of the U. S. Strategic Bombing Survey and has gained a good perspective of the German chemical process industries.

Dinner will be served at 7 p.m. at the Hans Jaeger Restaurant, Lexington Ave. at 85th St. Tickets may be purchased at the door at $2.60 ($2 to students).

AIR REDUCTION SETS UP NEW TECHNICAL SALES DIVISION

Organization of a new technical sales division within the company has been announced by C. D'W. Gibson, vice president in charge of sales for Air Reduction Co. The new division which replaces Airco's former applied engineering department is headed by Dr. George V. Slottman who has been with the company for 10 years and prior to that was professor of chemical engineering at Massachusetts Institute of Technology. S. D. Baumer and E. V. David who have been assistant managers of the applied engineering department are assistant managers to Dr. Slottman in the new sales division.

CELANESE CORP. TAKES OVER WAR PLANT IN NEW JERSEY

The plant at Belvidere, N. J., formerly operated by the New Jersey Powder Co. for the manufacture of smokeless powder, has been acquired by Celanese Corp. of America. The corporation will use the plant in the manufacture of chemicals and plastics and present plans call for an expansion program which will result in the ultimate expenditure of $10,000,000. Among the products to be made at Belvidere is the new Celanese plastic "Forticel." Celanese Plastics Corp., a wholly-owned subsidiary, will handle sales of all products made at the newly acquired plant.

SHERMAN HEADS COUNCIL OF COMMERCIAL LABORATORIES

Holding its eighth annual meeting at the Palmer House, Chicago, on December 10-11, the American Council of Commercial Laboratories adopted a resolution favoring the promotion and expansion of basic scientific research by tax-free and tax-supported organizations provided such research is promptly and widely published for the general good. However, the council proposed that all organizations doing research and testing for direct and exclusive benefit of profit-making groups be taxed on a par with competitive commercial organizations.

At the business session, Herbert L. Sherman of Skinner & Sherman, Inc., Boston, was elected president to succeed Major W. P. Putnam, Detroit Testing Laboratory, who remains as ex-officio director. Other officers elected are F. B. Porter, Southwestern Laboratories, Fort Worth, Tex., vice president; Bernard L. Oser, Food Research Laboratories, Long Island City, secretary; Gustavus J. Esselen, Gustavus J. Esselen, Inc., Boston, treasurer. New directors are R. R. Bowser, Bowser-Morner Testing Laboratories, Dayton, Ohio, I. F. Laucks, Laucks Laboratories, Seattle, Wash.; and M. C. Wylie, Gulick-Henderson Co., Pittsburgh.

CONVENTION CALENDAR

Technical Association of the Pulp and Paper Industry, annual meeting, Hotel Commodore, New York, N. Y., February 25-28.

Exposition of Chemical Industries, 20th exposition, Grand Central Palace, New York, N. Y., February 25-March 2.

American Institute of Chemical Engineers, regional meeting, Hotel Biltmore, New York, N. Y., February 26-27.

American Gas Association, conference on industrial and commercial gas, Commodore Perry Hotel, Toledo, Ohio, March 29-30.

American Management Association, conference and packaging exposition, Public Auditorium, Atlantic City, N. J., April 2-5.

Midwest Power Conference, annual meeting, Palmer House, Chicago, Ill., April 3-5.

American Chemical Society, 109th meeting, general headquarters, Hotel Claridge, Atlantic City, N. J., April 8-12.

The Electrochemical Society, Inc., national meeting, Tutwiler Hotel, Birmingham, Ala., April 11-13.

First National Exposition of the Plastics Industry, sponsored by The Society of the Plastics Industry, Grand Central Palace, New York, N. Y., April 22-27.

American Ceramic Society, 48th annual meeting, Hotel Statler, Buffalo, N. Y., April 28-May 1.

National Association of Corrosion Engineers, annual meeting, President Hotel, Kansas City, Mo., May 7-9.

Society for the Promotion of Engineering Education, 53rd annual meeting, Jefferson Hotel, St. Louis, Mo., June 20-23.

Fourth National Chemical Exposition, Chicago, Ill., September 10-14.

DIAMOND ALKALI BROADENS SALES ACTIVITIES

At the beginning of the year the Diamond Alkali Sales Corp., Pittsburgh, took over the operation of the Baltimore and Boston branches of Sunshine Soda Co. The Baltimore branch will be merged with Diamond's Philadelphia office of which C. F. Wolters, Jr., is manager. H. A. Kurtz and A. DePhillips, former Sunshine Soda representatives, will continue to supply local requirements from warehouses in Baltimore and Washington. A new Diamond Alkali sales office has been established in Boston at 80 Federal St., with H. B. Clark as manager. At Memphis, Tenn., R. B. Perry, recently released from the Navy, has succeeded E. A. Jones as manager.

UNITED STATES RUBBER CO. ELECTS VICE PRESIDENTS

An announcement by Herbert E. Smith, president of the United States Rubber Co., states that the company has elected five new vice presidents. They are Ernest G. Brown, general manager of the mechanical goods, general products, and "Lastex" yarn and rubber thread divisions; John P. Coe, general manager of the Naugatuck chemical and synthetic rubber divisions; H. Gordon Smith, general manager of the textile division; John W. McGovern, general manager of the tire division; and Elmer H White, general manager of the footwear and fuel cell divisions. Each new vice president will retain his title of general manager and will continue his division management duties.

BURPEE HEADS CHEMICAL DRIVE FOR DAV FUND

George W. Burpee, president of General Aniline & Film Corp., New York, has accepted the chairmanship of the Chemicals Division for the National Service Fund of the Disabled American Veterans, according to Charles Shipman Payson, chairman of the board of Refined Syrups and Sugars, Inc., who is the Fund chairman.

The DAV is a congressionally-chartered organization which was formed in 1920 to help veterans in the preparation and prosecution of their just claims for benefits and to assist them in their employment and other rehabilitation problems. In the last 25 years it has built up, in close cooperation with the Veterans Administration, the most extensive and effective service setup of its kind in the country.

Due to the large numbers of disabled veterans of World War II who need its direct, personalized assistance, this organization is appealing to the public for support of its service expansion program. Through its

National Service Fund, with headquarters at 41 East 42nd St., New York, the DAV is conducting a national campaign for $10,000,000.

GOODRICH BREAKS GROUND FOR NEW RESEARCH LABORATORIES

While the actual anniversary of the company falls on December 31, the B. F. Goodrich Co. of Akron postponed the celebration of its 75th anniversary to January 3 so that it coincided with the breaking of ground for a new research center. The new laboratories will be erected on a 260-acre tract near Brecksville midway between Akron and Cleveland. Dr. Howard E. Fritz, the company's director of research, says the outstanding characteristic of the new laboratories will be adaptability for rapid conversion from one type of work to another. Removable partitions, interchangeable fixtures and a wide variety of special services will be employed.

Present plans call for five separate air conditioned buildings built of gray brick. The main research building will be T-shaped and will include 81 individualized laboratories, a cafeteria and dining room, an assembly room and an extensive technical library. The second building, also three stories high, will house physical testing, chemical engineering research, complete shops, receiving and store rooms, and necessary power units. A special "high-pressure" building equipped with barricades and instruments for safety will be provided in which chemical reactions will be tested. There also will be a highly ventilated building for research on toxic materials and a separate building for the storage of solvents.

NEW YORK STATE EXPANDS APPRENTICE TRAINING

Returning veterans have forced an expansion of the apprentice training program in New York State. The demand for skilled journeymen still exceeds the supply according to the New York State Department of Labor. The department revealed that three quarters of the 3,296 apprentices are veterans. It also disclosed that a large percentage of the 800 establishments assisting in this on-the-job training have inaugurated their local programs in the past six months. Among the apprentice training programs that have been established, are the following courses of interest to the chemical industry: boilermaker, diemaker and sinterer, glazier, machinist, and toolmaker.

NATIONAL CARBON PURCHASES PLANT AT CHARLOTTE

Negotiations have been completed with the Reconstruction Finance Corp. by National Carbon Co., Inc., a unit of Union Carbide & Carbon Corp., for the purchase of the Army Signal Corps. battery manufacturing plant at Charlotte, N. C., for conversion to civilian operation. The purchase price was not disclosed but it is reported that the property had been appraised for RFC at an amount substantially in excess of $350,000. During the war, National Carbon operated this plant for the government to produce batteries used for "walkie-talkies" and other military communications equipment. The plant will continue to manu-

facture batteries of a variety of types in a wide range of power for both general and special uses.

The company also is constructing a three-story addition to the laboratory of its plant at Bennington, Vt. This plant will be the headquarters for the fabrication of "Krene" plastics products, recently introduced in the form of waterproof and mildew-proof shower curtains and ruffled window curtains.

SYMPOSIUM ON CORROSION AT ASTM SPRING MEETING

The two technical features of the spring meeting of the American Society for Testing Materials which will be held at the Hotel William Penn, Pittsburgh, February 26-27, involve several papers relating to statistical quality control and its relation to specifications and the symposium on atmospheric exposure tests of non-ferrous metals and alloys. The quality control session will be held on the evening of February 26 and the symposium on corrosion will be held in two sessions on the afternoon and evening of February 27.

CHLORINE INSTITUTE HOLDS ANNUAL MEETING

At its annual meeting held in New York, on January 30, the Chlorine Institute, Inc., reelected S. W. Jacobs as president. Other officers also were reelected—E. C. Speiden, vice president and Robert T. Baldwin, secretary and treasurer. Directors elected for two-year terms included the president and vice president; George M. Dunning, Wyandotte Chemicals Corp.; F. W. Fraley, Diamond Alkali Co.; and R. W. Hooker, Hooker Electrochemical Co. At the dinner preceding the meeting, Major General Alden H. Waitt, chief of Chemical Warfare Service, presented a certificate of appreciation to Mr. Jacobs for assuring CWS and the War Department an adequate supply of chlorine during the war.

B. F. GOODRICH WILL BUILD NEW PLASTICS PLANT

Construction soon will start on a new modern plant for the processing of plastics near Marietta, Ohio. It will be built for the B. F. Goodrich Co. on a 66-acre tract on the west bank of the Muskingum River. Cost of the entire project will be approximately $4,000,000. The plant will employ about 250 men and women and only a small staff of supervisory, technical and scientific men will be transferred there from other plants of the company.

MELLON INSTITUTE HAS NEW RESEARCH DEPARTMENT

An announcement by Dr. Edward R. Weidlein, director of Mellon Institute carries the information that the Institute is engaging in a wide program of research embracing the new chemicophysical techniques. A new department in chemical physics has been established which will devote about half its time to service to the fellowships and the remainder to fundamental investigations of its own choice. Dr. H. R. Klug, formerly of the faculty of the University of Minnesota, is in charge of the new activities which will include work on x-ray diffraction.

electron diffraction, electron microscopy, chemical microscopy, and the branches of spectroscopy.

SALE OF WAR SURPLUS GOODS THROUGH DECEMBER 1945

Disposals by the War Assets Corp. of surplus capital and producers' goods and aircraft to the end of last December show a return to the government of 39 percent of cost. Property having a reported cost of $511,320,000 was sold for $200,639,000—this total not including industrial plants and real estate. As of Dec. 31, 1945, 231 government-owned war plants had been sold or leased or put into civilian operation through short term leases with their wartime lessees. These plants represent a government investment of approximately $1,070,681,000.

The report issued by the War Assets Corp. shows that sales of war surplus chemicals and allied products through last December reached a total of $4,897,000 which carried a cost price of $8,113,000. Hence returns on sales of chemicals were a little better than 60 percent as compared with a 39 percent return on the sales for all products. There was a wide variation in the percentage of returns on sales of different types of chemical products with cyclic intermediates scoring close to 86 percent of the cost price but the volume of sales in that classification was relatively low and it would appear that chemical warfare agents, except phosgene—cost price $1,226,000, resale price $1,024,000—actually made the best showing.

The report also lists the value of chemical products still in the possession of government agencies at the end of the year. The total is placed at $50,871,000 which means that only a small part of the surplus entered into the previous transactions. Miscellaneous chemicals including industrial chemical products, miscellaneous organic chemicals, and paints, varnishes and lacquers account for about one-half of the unsold commodities in this classification.

Accumulative Sales of Surplus Chemicals and Allied Products Through December 31, 1945*

Chemicals	Sales		On Hand Dec. 31, 1945
	Cost Price	Sales Price	Reported Cost
Heavy chemicals	$406	$203	$1,073
Industrial, industrial fine, and related chemicals	1,324	580	4,852
Coal and petroleum crudes	210	94	2,737
Intermediates, cylic	140	120	3,002
Dyes	97	68	3,315
Miscellaneous organic chemicals	2,756	1,784	7,656
Chemical warfare agents, except phosgene	1,226	1,024	2,012
Paints, varnishes, lacquers, japans, thinners	869	469	7,112
High explosives	38	23	3,074
Miscellaneous chemicals, includes industrial products	488	171	10,781
Other chemicals	476	293	4,063
Condensation plastics	83	59	1,194
Total	$8,113	$4,897	$50,871

* All prices in thousands of dollars

PACIFIC PROCESS INDUSTRIES

TRENDS • EVENTS • DEVELOPMENTS

JOHN R. CALLAHAM, Pacific Coast Editor, San Francisco, Calif.

WEST COAST ENGINEERS PLAN CONVENTION

Having just elected new officers for the coming year, the recently organized Northern California Chapter of the American Institute of Chemical Engineers, the third institute chapter west of the Mississippi and the second west of the Rockies, is now making tentative plans for a regional convention during the coming year. If these plans materialize, the first AIChE convention in the West since 1924 will be held in California.

Under the chairmanship of C. R. Nelson of Shell Development Co., San Francisco, the Northern California chapter was topped last year only by the Metropolitan New York chapter in having the highest average meeting attendance of all the 21 local institute sections. In terms of ratio of attendance to total membership, the California chapter took national first place. This record is emphasized by the fact that the section was first organized during the fall of 1944 and was officially recognized only last December at the Chicago national convention. Officers recently elected to guide the Northern California chapter in its second year are A. George Stern, Westvaco Chlorine Products Corp., Newark, as chairman; John R. Callaham, *Chemical & Metallurgical Engineering*, San Francisco, as vice-chairman; Jose Samaniego, Shell Development Co., San Francisco, as secretary-treasurer. Elected to the executive committee were J. H. Arnold, California Research Corp., Richmond; P. M. Huemmer, Union Oil Co., Oleum; and B. W. Van Arsdel, Western Regional Research Laboratory, U. S. Dept. of Agriculture, Albany.

SHELL DOUBLES AMMONIA PRODUCTION FACILITIES

More than $1,000,000 will be spent this year by Shell Chemical Corp. to double production capacity of ammonia and ammonium sulphate at the firm's plant at Shell Point, near Pittsburg, Calif., according to a recent announcement by J. Oostermeyer, president. In operation since 1931, the Shell Point synthetic ammonia plant was the first in the country to use natural gas as a source of hydrogen. By far the largest of the three ammonia plants in the West, all in California, the Shell Point unit has provided a major portion of the nitrogen plant food used in western agriculture, usage of which has doubled in California since 1938. In addition, the new facilities will produce anhydrous ammonia for industrial purposes.

At the same time, it was announced that Shell Chemical Corp. recently broke ground for a new office building at Shell Point to accommodate the approximately 100 office workers now employed at this works. A total of some 400 people are at present employed at Shell Point, according to M. Voogd, plant manager.

BAY SCIENTISTS ORGANIZE TO INFLUENCE ATOM CONTROL

A group of Bay Area scientists held a preliminary organizational meeting during December in Berkeley to form the nucleus of what is tentatively called the Northern California Association of Scientists. Similar groups formed in other parts of the country are mostly now united in the new American Federation of Scientists. These groups will be in close touch with the Bay Area committee which may in turn be affiliated with the national organization. The group's aims are to promote the attainment and use of scientific and technological advances in the best interests of humanity. The immediate objective is to influence achievement of the best possible form of international control of atomic energy.

WEST'S ORGANIC MEDICINAL PRODUCTION RISES

There is now one commercial producer of bulk synthetic organic medicinals in the entire eleven western states, according to available information. The new producer is Van Camp Laboratories, Terminal Island, Calif., which has a line of about a dozen amino and related compounds. In 1940, there was no western producer of synthetic organic chemicals intended primarily for medicinal use whereas in the entire country there were almost 50 firms synthesizing more than 250 such medicinals. However, since 1943 the Cutter Laboratories, Berkeley, Calif., has produced penicillin on a large scale and since 1944 has been a producer of blood plasma proteins. This firm is the West's only large primary producer of biologicals and serums.

In the synthetic organic field, however, interest seems to be increasing. There is limited production of ethylene disulphonate in Southern California and the new amino products plant of International Minerals & Chemical Corp. now under construction at San Jose will be able to produce pharmaceutical products such as betaine hydrochloride and tyrosine. In addition, at least one large eastern manufacturer of chemical medicinals has been making preliminary plant site surveys on the Pacific Coast.

CALIFORNIA RESEARCH CORP. TO EXPAND

A major expansion of present California Research Corp. laboratory facilities at Richmond and El Segundo, Calif., has been announced by R. G. Follis, president of Standard Oil Co. of Calif. Follis stated that the $2,000,000 expansion would be in line with the parent firm's increasing emphasis on research to provide new products from petroleum and to extend their markets. "The war has proved that petroleum is perhaps the most versatile of our natural resources and that the possibilities for further development are virtually unlimited," he added.

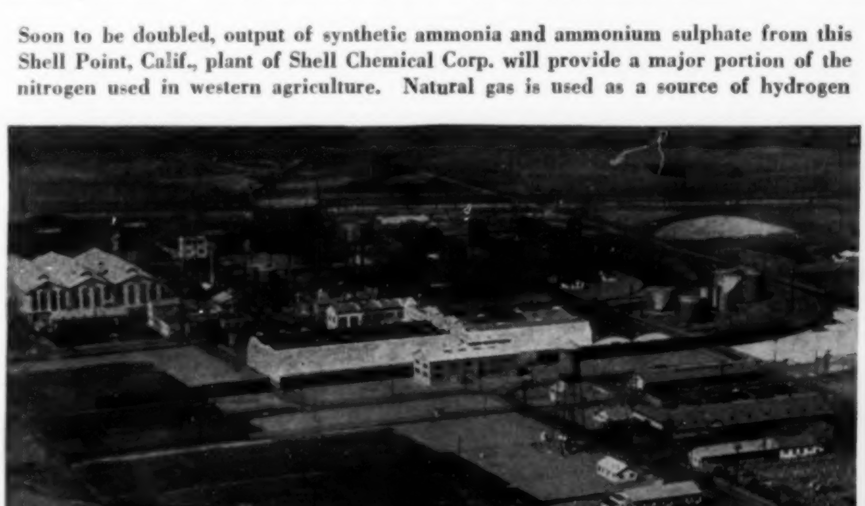
California Research has a staff of more than 600, including many scientists outstanding in petroleum chemistry and other allied fields.

TEXAS ANNOUNCES MAJOR WYOMING EXPANSION

An expansion program involving expenditure of about $6,000,000 at its refinery in Casper, Wyo., has been announced by the Texas Co. Principal improvement will be a new fluid catalytic cracking and gas recovery unit, costing in the neighborhood of $4,500,000, which will enable the company to supply high-octane gasoline from the Casper works. Heretofore it has been necessary to ship components of this type of gasoline from other refineries to Casper.

Other improvements include a new crude still and vacuum unit to provide products from crude. The existing thermal cracking equipment is to be increased in capacity and modernized to permit the manufacture of high-quality products; facilities for manufac-

Soon to be doubled, output of synthetic ammonia and ammonium sulphate from this Shell Point, Calif., plant of Shell Chemical Corp. will provide a major portion of the nitrogen used in western agriculture. Natural gas is used as a source of hydrogen



ture of road oil and asphalt products to supply the demand in the Casper area will also be installed. Work is expected to begin next spring and to be completed by the end of the year. The Texas Co. also has refineries at Cody and Calpet, Wyo., and at Craig, Colo.

ESSENTIAL OIL PLANTS SUITABLE FOR SAN DIEGO

POINTING out that the coastal areas near San Diego come closer than any other section of this country to duplicating the climatic conditions of the Mediterranean Basin, the Natural Resources Committee of this city is asking the U. S. Department of Agriculture to establish a permanent experimental station in the region. By cultivation of valuable medicinal plants such as belladonna and stramonium and of various essential oil plants used in the manufacture of perfumes and aromatic products, it is claimed that the nation's chemical industries as well as agriculture would benefit. Domestic requirements of certain natural plant products for the medicinal and essential oil industries are now largely imported.

DOW EXPANDS AGRICULTURAL CHEMICALS OUTPUT

ENLARGED facilities for production of agricultural chemicals at the Pittsburg, Calif., plant of the Great Western Division of Dow Chemical Co. were recently made known. It is planned to increase production of the firm's line of DN dusts, soil fumigants, weed killers and herbicides to supplement the present western production, now largely centered at Dow's Seal Beach, Calif., plant. Output from Pittsburg will be destined largely for northern California and the Pacific Northwest, while Seal Beach operations will continue to serve southern California and the Southwest. R. L. Curtis, San Francisco, is general manager of Dow's Great Western Division.

NORTHWEST PLYWOOD GLUE CONSUMPTION DROPS

REFLECTING the strike that began in the Pacific Northwest wood industries in September, consumption of softwood plywood glue during October dropped to the lowest point in four years, according to a report by the U. S. Department of Commerce. Of the 29 softwood plywood companies in the country, 26 are in the Pacific Northwest where 23 firms use Douglas fir and three use Ponderosa pine. Of the 29 companies comprising this industry, 14 were not in production during October.

Total consumption of glue for softwood plywood dropped from 3,436,000 lb. in September to 2,851,000 lb. in October, while the October, 1944, figure was 4,686,000 lb. Consumption of glue by types for the industry is shown in the accompanying table.

Glue Consumption in Softwood Plywood

	Oct. 1945	Oct. 1944
	(Thousand Pounds)	
Casein	126	107
Soybean	1,488	2,431
Phenolic resin	1,191	1,948
Other	46	200
Total	2,851	4,686

CHINA ITEMIZES CHEMICAL RECONSTRUCTION NEEDS

THE Chinese government, through its purchasing commission office in Washington, D. C., hopes to obtain $2,000,000,000 of imports from this country to aid in China's reconstruction and industrialization program, according to Alex Taub, industrial consultant for the China-American Council of Commerce and Industry, at a recent meeting in Portland, Ore. Industry needs were estimated at $920,000,000 (U. S.) of which $125,000,000 would represent chemicals and basic processing plants. Estimated first year expenditures for this group would be close to $50,000,000. The following table itemizes some of the chemical and related items which China hopes to obtain.

	Additional Yearly Production, Tons	Cost of Imports from U. S.
Refractories	5,000	$1,000,000
Aluminum plant	20,000	40,000,000
Fertilizers	......	50,000,000
Inorganics and chlorine prod	......	10,000,000
Carbide and organics	......	20,000,000
Alcohol	......	5,000,000
Rayon	......	9,000,000
Paper	......	20,000,000
Rubber	......	5,000,000
Cement	......	6,000,000
Soap	40,000	2,000,000
Cane sugar	90,000	9,000,000
Glass	15,000	2,000,000
Salt	60,000	1,500,000
Vegetable oils	60,000	3,000,000
Enamelware, etc	......	1,000,000

ALUMINA PLANT MAKES AMMONIUM SULPHATE

HAVING repaired the breakdown in the crystallizers caused by failure of a war-substitute lining material, the government alumina-from-clay plant at Salem, Ore., has resumed production of ammonium sulphate for Oregon agriculturists after having produced over 1,500 of the first 2,500 tons of this fertilizer allocated by RFC to the state's farmers. Because of the difficulty in obtaining ammonium sulphate from which to make ammonium bisulphate used in the clay digestion step, the alumina plant has been forced to make the chemical from ammonia and sulphuric acid. According to reports, the plant will probably continue to make badly needed agricultural ammonium sulphate as long as this does not interfere with production of alumina from clay.

SHELL CHEMICAL PLANS EXPANSION PROGRAM

IN PREPARATION for a large expansion program, Shell Chemical Corp. was recently incorporated in Delaware to take over and contine the business of Shell Chemical Div. of Shell Union Oil Corp. The head office will be located in the Shell Building, San Francisco, and the corporation will be a wholly-owned subsidiary of Shell Oil Co., Inc., it was announced by J. Oostermeyer, president of the new concern. Other officers elected for the corporation include W. P. Gage and L. V. Steck, vice presidents, and J. W. Watson, treasurer.

The new corporation, which employs approximately 2,000 people, will continue operation of the three chemical plants in California at Shell Point, Martinez and Dominguez and will continue manufacturing their major products which include ammonia, fertilizers, solvents and organic chemicals. It will also operate the butadiene plant at Torrence, Calif., and will later take over Shell Oil's allyl chemical plant in Houston, Tex. Future activities will be directed toward further development of petroleum derivatives throughout the country.

INTENSIVE DEVELOPMENT OF GILSONITE BEGINS

GILSONITE, a hard, shiny-black hydrocarbon closely related to petroleum, will shortly be under intensive development by the American Gilsonite Co., a new company equally owned by Standard Oil of Calif. and the Barber Asphalt Corp. The world's only known important source of gilsonite lies in fields in eastern Utah and western Colorado, where it is found in vertical veins varying in widths up to 18 ft., several miles in length and more than 1,000 ft. in depth. It is mined virtually pure in large tonnages at Bonanza, Utah, and trucked to Craig, Colo. The gilsonite fields formerly owned by the Barber Corp. comprise the greater part of the known reserves in the Utah-Colorado area. Clarence F. Hansen, formerly chief engineer in Standard's manufacturing department, will be president of the new company.

Because of its resistance to acid, gilsonite is used in the manufacture of storage battery cases, while its high melting point is important in making foundry forms. Now used in paints, varnishes and inks, it may later be developed as a binder for plastics.

OUTPUT OF CAUSTIC CALCINED MAGNESIA INCREASES

DOMESTIC production of caustic calcined magnesia, made almost wholly by Westvaco Chlorine Products Corp. in California, increased from 10,000 tons in 1939 to 30,000-35,000 tons annually during the war, according to a survey by the U. S. Tariff Commission. Of the 1944 output, 16,000 tons came from crude magnesite while 19,000 tons was made from sea-water magnesia. These figures do not include the magnesia produced for use in manufacture of magnesium metal. Westvaco Chlorine Products Corp. operates magnesite mines in California and Nevada and a sea-water magnesia plant at Newark, Calif.

Although chief use of caustic calcined magnesia has been for manufacture of oxychloride cement, new uses include up to 4,000 tons annually as a catalyst in synthetic rubber and increasing quantities as a coagulating medium in rayon manufacture and as an admixture in commercial fertilizers. These latter uses are expected to continue their upward trend.

RESINOUS ION EXCHANGER OUTPUT RISES

Now becoming generally available to industry for the first time since initial production in 1942, the synthetic resin ion exchangers produced by Chemical Process Co. are finding so many outlets that the firm is making plans for increasing its production, according to B. N. Dickinson of the San

Francisco office. Output of the firm, one of the five basic producers of synthetic resin ion exchangers in the United States and the sole producer west of the Rockies, formerly went to the Navy and other war-essential users. The firm, an affiliate of James D. Dole & Associates of San Francisco, was one of the early workers in the field of sugar purification through resin ion exchangers. Its products, known as the "Duolite" series consisting of two cation exchangers and three anion absorbing types, are now used chiefly in water softening and water demineralization. It is anticipated, however, that usage will soon be expanded to include the entire field of industrial ion removal, including sugar purification. Paul Gross is superintendent of the plant near San Francisco, which employs about 20 workers, while Dr. Gordon F. Mills is in charge of the research laboratory.

SPOKANE ALUMINUM OUTLOOK BRIGHTENS

Prospect that the government-owned aluminum plants at Spokane and Troutdale, Ore., may resume operations improved in mid-January when Reynolds Metals Co. stated that the company was interested in operating the plants. This statement followed the announcement that Reynolds had obtained permission to use royalty-free the patents of Aluminum Co. of America relating to production of alumina by the Bayer process. Reynolds has leased the government's big Hurricane Creek, Ark., alumina plant and has agreed to sell alumina in excess of its own needs at cost plus 6 percent. This agreement assures a source of supply of alumina for the Spokane and Troutdale plants regardless of whether these plants should be operated by Reynolds or by some other private firm. Reynolds Metals Co. has an ingot plant at Longview, Wash.

LEVULOSE SUGAR MILL PLANS UNDER WAY

With the Jerusalem artichoke as raw material, the newly-incorporated Columbia Engineering & Supply Co., Vancouver, Wash., plans to build in the near future a plant to produce levulose or fructose sugar, according to reports. The plant, probably to be located at Camas, Wash., is expected to cost in the neighborhood of $500,000 and will be known as the Columbia Levulose Sugar & Refinery Co. Levulose, a hexose sugar, can be produced by warm acid hydrolysis of inulin, a semicrystalline polysaccharide found in the Jerusalem artichoke. By addition of lime, the sugar is first crystallized as the calcium salt. Treatment with carbon dioxide liberates a purified levulose which can then be crystallized. The sugar is widely used in medicine and as a sweetening agent in certain foodstuffs.

SUGAR BEET BYPRODUCTS RESEARCH AT WYOMING

With the hopes of developing a cheap industrial pectin from byproduct sugar beet pulp, research has been under way for over a year by Dr. Andrew Van Hook and Dr. Elizabeth Roboz of the Natural Resources Research Institute, University of Wyoming, Laramie. The byproducts proj-


PITTSBURGH
• DES MOINES
Industrial
ELEVATED
STEEL TANKS
For every varied industrial water storage need, Pittsburgh-Des Moines supplies the *right* standard or special Elevated Steel Tank—correct in type, size, and function. Built with unrivalled experience and craftsmanship for performance, furnishing top values in dependable water service, property protection and insurance savings. *Write for our latest Brochure*
PITTSBURGH · DES MOINES STEEL CO.
PITTSBURGH, PA., 3414 NEVILLE ISLAND—DES MOINES, IOWA, 915 TUTTLE STREET
NEW YORK, ROOM 916, 270 BROADWAY · CHICAGO, 1218 FIRST NATIONAL BANK BUILDING

ect, initiated by the Sugar Research Foundation, is under the guidance of Dr. H. G. Fisk, director of the institute.

Purposes of the study are to investigate the extraction and purification of pectin from byproduct sugar beet pulp, which contains on a dry basis about 25-30 percent of this constituent. Pectin from this source is inferior in gelling quality to that from fruits, but development of a relatively cheap pectin for industrial applications where high gelling strength is not of paramount importance might offer considerable economic benefits to sugar beet processors as well as longer periods of employment for workers in sugar beet factories.

WOOD BRIQUETTE PLANTS BEING CONSTRUCTED

A two-machine Pres-to-logs plant is being built adjacent to the State Box Co., West Sacramento, Calif., by Wood Briquettes, Inc., Lewiston, Idaho, according to a recent announcement by Roy Huffman, general manager of Wood Briquettes. While the policy of the company has been to lease their machines, in this instance it is building the plant itself and will purchase the wood refuse raw material from the State Box Co. The plant was expected to operate by Jan. 1, 1946, and in full operation will produce about 8,000 tons of fuel briquettes annually from wood waste for the California market.

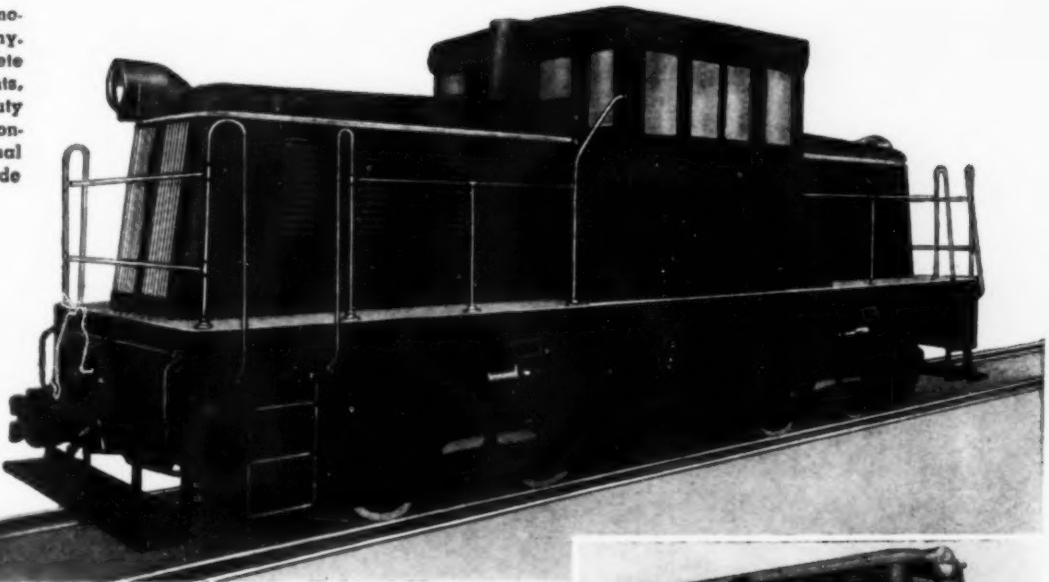
At the same time it was announced that a license contract had been completed by Wood Briquettes, to cover the installation of two Pres-to-log machines at the plant of Caldwell Lumber Co., Caldwell, Idaho, which is affiliated with the J. R. Simplot dehydrating interests. It is anticipated that the machines will be completed in February. Their capacity will be 8,000 tons of wood briquettes annually for the southern Idaho market. These two new plants will bring the yearly production of Pres-to-log briquettes well above 200,000 tons.

PERMANENTE TO RESUME MAGNESIUM PRODUCTION

Announcement has been made by Henry J. Kaiser, president of Permanente Metals Corp., that the government has been repaid in full for its RFC loan of $28,475,000 on the carbothermic magnesium plant at Permanente, near San Jose, and allied plants at Moss Landing and Natividad, Calif. The Moss Landing plant recovers magnesium oxide from raw sea water and calcined dolomite, supplied by Natividad. Present plans are reported to call for a return to magnesium metal production as soon as process simplification can be completely worked out.

The Permanente magnesium plant, built in 1941, produced 10,000 tons of ingot and 43,000 tons of incendiary material for the war effort. The latter product, a magnesium-oil bomb filler known as "goop," was important in the leveling of Japanese industrial centers. Permanente was the only magnesium plant in the United States capable of supplying this material. Moss Landing and Natividad, now operating at capacity, were established to supply the magnesium plant with raw material, but have since developed other products in demand by industry.

70-Ton, 56½" gauge, Locomotive for large steel company. Equipped with two complete Diesel-electric power plants, four high-speed heavy-duty traction motors and dual control, for operation with equal convenience from either side of cab.



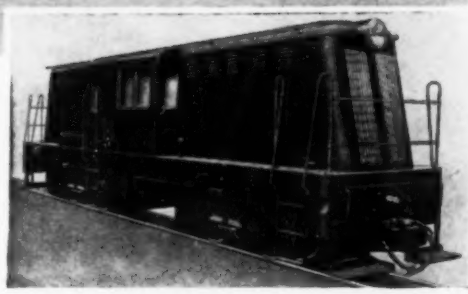
Diesel-Electric Locomotives

Wide or Narrow Gauge

The Vulcan Diesel-Electric Locomotives here illustrated are typical of many others now operating successfully throughout the United States and other countries—few of which are exactly alike, yet all of which embody certain distinctive features of design and construction which have proved advantageous, and thoroughly dependable, under a wide range of operating conditions.

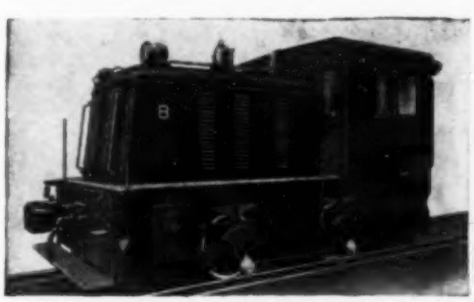
One of these features is a compact but powerful enclosed driving-gear assembly which not only permits an unusually wide range of reduction ratios but also any desired track gauge down to 30" in width. Other distinctive Vulcan features are illustrated and described in new bulletins which will be mailed promptly on request.

Correspondence is invited regarding any locomotive requirement up to approximately 100 tons in weight—Diesel-Electric, Diesel Geared or Steam. Our experienced engineers welcome opportunities to make recommendations and submit proposals for "custom-built" locomotives which will give best possible results under any specified combination of operating conditions.



65-Ton, 30" gauge, locomotive for well-known mining company; designed for minimum height and width. Two complete power plants and four traction motors.

50-Ton, 56½" gauge, locomotive for industrial plant. Two complete power plants and two traction motors.



25-Ton, 60" gauge, locomotive for service in Canal Zone. One complete power plant and one traction motor.

VULCAN IRON WORKS

WILKES-BARRE, PA., U. S. A.

NEWS FROM ABROAD

MARKETS FOR CHEMICALS IN GREAT BRITAIN REFLECT ELIMINATION OF PRODUCTION BOTTLENECKS

Special Correspondence

The British chemical markets entered the new year with a firm and steady tone, and most manufacturers do not doubt that active conditions will characterize trade throughout 1946. At home civilian consumer industries are finding it easier to overcome raw material and labor shortages, and demand for industrial chemicals rises proportionately to the general expansion of activity in such trades as textiles, shoes, glass, pottery, household goods, with the building industry promising soon to surpass all others in importance as a buyer of chemical products. In the export market inquiries are still far in excess of available supplies, although the authorities favor the foreign customer. The monthly export returns seem to reveal a somewhat spasmodic and intermittent expansion, but the latest figures confirm the impression that the chemical trades will hold their place among Britain's leading exporters.

PHARMACEUTICAL COMBINE

In the pharmaceutical trade the government has given a stimulus to sales abroad by removing export control from various products, with the result that few medicinal chemicals are now subject to export license. A number of leading pharmaceutical manufacturers have formed a new company, styled British-European Pharmaceutical Co. Ltd., for marketing medical products in certain countries in Europe. For the time being the new company will confine its activities to Belgium, Bulgaria, Czechoslovakia, Denmark, Finland, Greece, Holland, Italy, Yugoslavia, Norway, Poland, Portugal, Rumania, Spain, Sweden and Switzerland. In other words, it will not operate in France, Germany, Hungary or the Soviet Union.

Members of the company, which was registered with a capital of £50,000, are Allen & Hanbury Ltd., Antigen Laboratories Ltd., Armour & Co. Ltd., The British Drug Houses Ltd., Evans Medical Supplies Ltd., and Vitamins Ltd. Several of these firms have for some time been cooperating in the British Therapeutical Corp. and are thus well acquainted with, and apparently in favor of, cooperative methods.

The new company is presumably intended to gain for British manufacturers part of the Continental markets vacated by Germany. In this aim it will meet strong competition from Swiss and French firms, but the choice of cooperative methods should, it is thought, give the new venture a fair chance of success. In overseas markets such collective marketing has so far not been adopted, because neither marketing nor financial conditions create as great complications as in Continental Europe. In the Dominion markets in particular it is generally thought advances must be sought in cooperation with local manufacturers or distributors.

An outstanding development in this direction is the agreement announced at the close of last year of Imperial Chemical Industries Ltd. and Messrs. Tatas for the establishment in India of "an industry for the manufacture of the whole range of dyestuffs." The production is to be developed to an extent sufficient to meet all Indian requirements. The agreement has two features which attract special attention. In the first place, it has been agreed that until the whole demand of Indian dyestuffs consumers can be met by the new joint company's output, the dyes made in India and those imported by I.C.I. will be sold jointly. Without making the full range of dyestuffs itself, the new company will thus be able to provide all required products for Indian consumers, and it seems likely that even when full production has been attained, certain specialized products will still be more advantageously obtainable by import.

Secondly, the capital and directorate of the new company will be predominantly Indian, while I.C.I. undertakes to provide all the necessary technical information and knowledge at their disposal. The formation of the new company thus does not necessitate any export of British capital to which the authorities might have objected on financial grounds, but as the technical methods used will be British it seems likely that the apparatus, machinery and equipment will also be ordered from British firms if obtainable without undue delay. The export of technical and chemical research and experience in the form of such agreements (the one in question is for twenty years) takes the place of the formation of overseas subsidiaries for the exploitation of British industrial knowledge because long-term investment of British capital abroad is impossible in present foreign currency conditions.

FINANCIAL CONSIDERATIONS

Even normal commercial relations with foreign countries must to a notable extent depend upon currency considerations. The loan obtained under the Anglo-United States financial agreement is in the view of government experts cut rather fine and will certainly not enable Great Britain to finance its trade with other countries. In the near future a similar loan is to be negotiated with Canada, and even Switzerland, a small country which tries to keep aloof in financial as in other respects, is understood to consider the grant of a credit to Britain as part of a commercial agreement in order to open the British market for Swiss merchandise, including, of course, chemicals, pharmaceuticals and dyestuffs.

The Scandinavian countries have for similar reasons shown themselves willing to extend credit facilities for British purchases. In trade with France, on the other hand, Britain has had to assume the role of creditor, but it is hoped that now, after the devaluation of the franc, commerce between the two countries will be on a more even footing. French chemical and allied products for the British market include cosmetics of which certain quantities have been admitted by the British authorities in spite of

the austerity insisted upon in other imports.

Manufacturers of organic chemicals generally welcome the decision of the government to nationalize the coal mining industry and to extend the nationalization to the coke-oven industry. The Ministry of Fuel is strongly in favor of the use of smokeless fuel and industrial utilization of value byproducts which in the past went up the factory chimney. Coal processing prior to burning will probably be one of the mainstays of the new policy to arrest the continuous advance of coal-producing costs and prices and has been constantly urged by most experts. An expansion of coal processing and distillation is taken for granted, for instance, in the big I.C.I. scheme for a new heavy organic chemicals plant near Middlesborough (reported in these notes last month) and is to provide additional employment and diversification of industrial activity in northeast and northwest England, Scotland, and South Wales.

Coal distillers forecast a big expansion of their activities this year, but even so there remains a pressing shortage of such products as phenol, largely as a result of resumed production of peacetime goods. A leading producer of phenol found it necessary to announce publicly that all possible steps are taken to remove the market deficiency and that phenol as such is not exported in bulk. A new Benzole Control Order has been issued, but this provides for alterations only in details. Most coal-tar products in short supply are likely to remain under control for considerable time to come.

PENICILLIN PLANT

The big penicillin plant at Speke, Liverpool, came into production shortly before the end of 1945, but the output is still very small. Manufacture is described as in a very preliminary stage. By the middle of this year, however, an output of over 100 lb. of pure penicillin is expected every week, and it is also reported that the plant will, six months after production has started, export penicillin on a commercial basis. The plant at Speke is the biggest penicillin plant in Europe. It is owned by the government, but operated by a private firm, Distillers Co. Ltd.

Tentative arrangements for exporting penicillin already have been made. As far as other exports of pharmaceutical products is concerned, UNRRA is at present still the main customer. Practically all the surplus stocks of pharmaceutical products at the disposal of the government have gone to UNRRA, so that the surplus disposal company formed as a liaison between the authorities and the private firms interested in the distribution of drugs to ensure orderly marketing of the government surplus stores has hardly yet gone into action.

The ease with which surplus stocks of any kind are disposed of draws attention to a shortcoming which every now and then holds up industrial activity with very unpleasant results, namely, the absence of reserve stocks in most sectors of the British chemical trade. Although generally speaking supplies are far more plentiful than even a few months ago and although improvement goes on steadily, it quite frequently happens that important production plans are held up or threatened with delay so that the authorities must intervene because comparatively minor auxiliary raw materials or skilled workers are not available. Such minor incon-

venience cannot be avoided in the present transitionary stage when constant readjustment is needed to keep the expansion of ordinary peacetime production on an even keel, but it is to be hoped that as reserves are built up such hold-ups are eliminated.

ITALY WILL HAVE LARGE SURPLUS OF SULPHUR

Approximately 20,000 tons of crude sulphur will be available for export from Italy during the first half of 1946 according to reports from Rome to the Department of Commerce. Although this will be far below the prewar level, it indicates that the Italian industry is beginning to recover from the effects of the war. During the period of 1936-41 production averaged 348,000 metric tons annually 65 percent of which was exported.

Output in Sicily, which is the major producing area in Italy, ceased in August 1943 after the invasion. Operations were again initiated in December of that year but being deprived of power and transportation, and many mines being flooded, production was on a much reduced scale. Output was running about 5,000 tons a month during the final quarter of 1945.

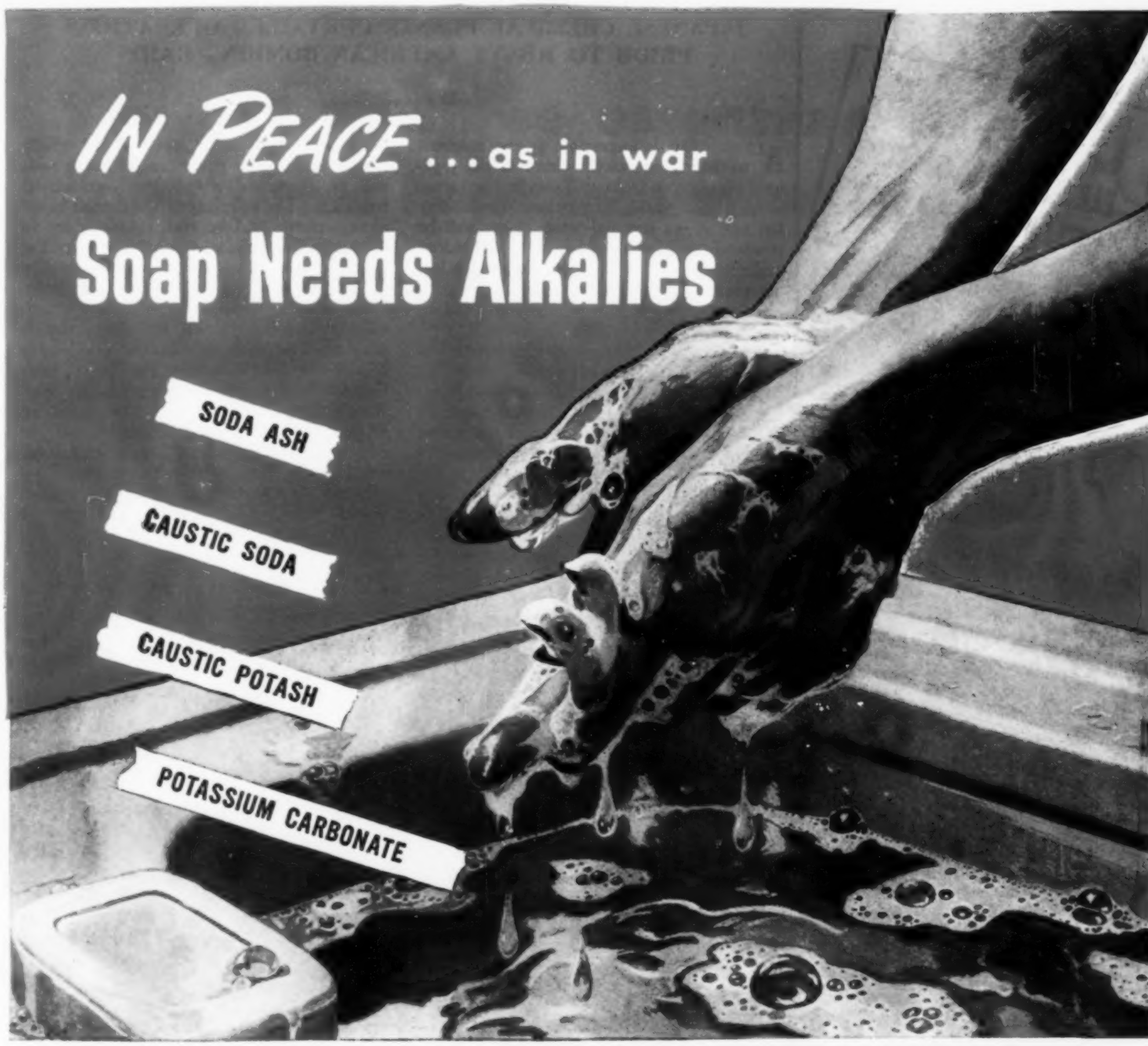
The outlook for 1946 is that 100,000 tons could be turned out during the year if the producers are not too greatly handicapped by lack of supplies, electric power shortage, insufficient transportation and financial difficulties. The sulphur consuming industries in Italy, particularly the manufacture of carbon bisulphide for rayon, will not be in a position to require normal quantities before the middle of 1946 thus permitting a greater surplus for export.

FRANCE PLACES ORDERS FOR RAILROAD EQUIPMENT

One of the obstacles in the way of reviving the French chemical industry has been the lack of transportation facilities for moving raw materials to producing plants and for delivering finished products to consumers. This condition holds true for all lines of manufacture and in order to revitalize its economy France has placed the largest postwar order for railroad equipment yet made by any foreign government. The Railway Purchasing Commission of the French Supply Council to the United States has ordered from the American Car and Foundry Co. of New York, 8,750 box cars and 4,000 gondola cars.

BELGIAN REQUIREMENTS FOR WINDOW GLASS

While there is an urgent demand for window glass in Belgium and attempts are being made to speed up production, the progress made to date has not been too encouraging. Belgian production in October reached a total of 800,000 square meters which represents a little more than 10 percent of the capacity of the plants. It was expected that production in November and December would be at about the October rate. Estimates made in November placed the requirements of the country at between 6,000,000 and 7,000,000 square meters. About three-quarters of the output is reserved for the repair of war damage.



Soap that builds up longer-lasting suds . . . soap with new ingredients for more effective use...soap that won't jell...Out of wartime research have come new types and forms of improved soap. Basic to soap making are alkalies and related products...proving that in peace as in war alkalies are indispensable!

SOLVAY SALES CORPORATION *Alkalies and Chemical Products Manufactured by The Solvay Process Company*

JAPANESE CHEMICAL PLANTS CURTAILED OPERATIONS PRIOR TO HEAVY AMERICAN BOMBING RAIDS

Special Correspondence

Although it is impossible at the moment to determine exactly what role the Japanese chemical industry will play in the future —since the Allied Reparations Committee has not as yet revealed what plants will be removed or destroyed—recent inventories make it plain, however, that Nippon has lost her prewar eminence which in the 30's saw her outstripping France and Italy in chemical production.

The Japanese government report to Allied authorities, recently made public, shows that the country's chemical production was tapering off even before the heavy American bombing raids got under way in the spring of 1945. In general, wartime production made a poor showing, most plants falling behind 1936-37 output.

Japan now possesses 20 plants for the fixation of atmospheric nitrogen, compared with 21 in 1937—but aggregate capacity has dropped from 490,000 tons to 108,700 tons. Only 82,000 tons now can be recovered as synthetic ammonia, compared with 400,000 tons in 1937, and sulphate of ammonia, the vital fertilizer of which Japan could produce 1,450,000 tons in 1938 has hit a 16-year low with a production capacity of 258,000 tons. This corresponds to the amount which Japan formerly imported to supplement her much larger production. In the fertilizer field only calcium superphosphate has held its own, with present capacity at 1,500,000 tons.

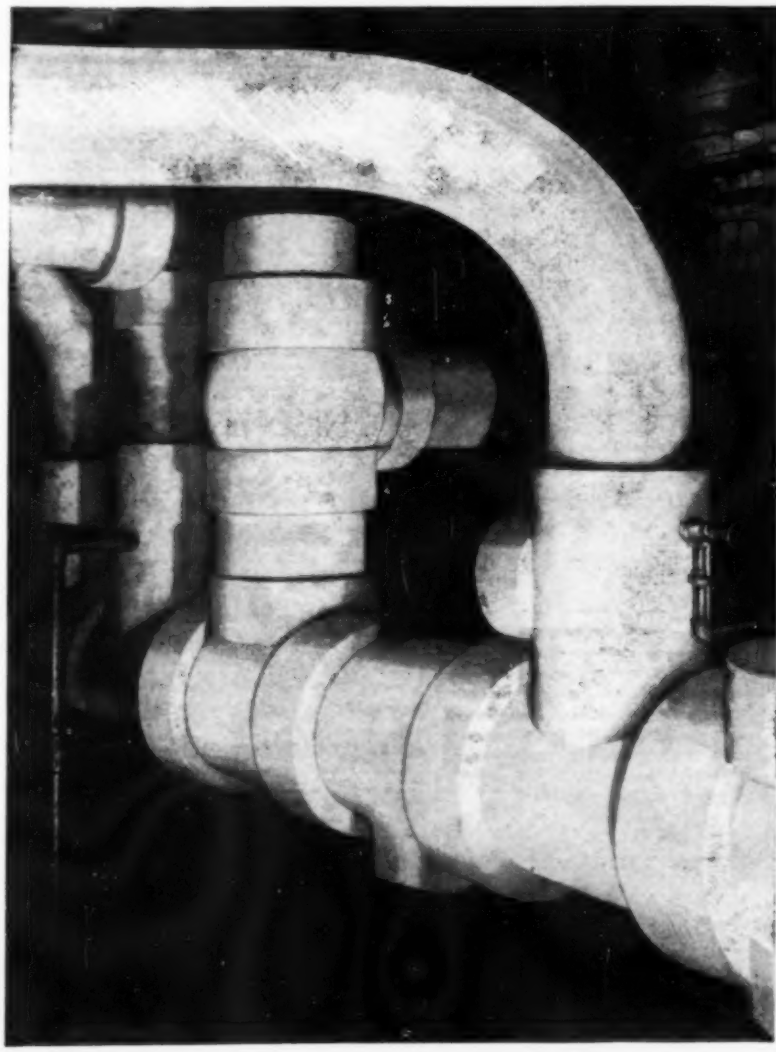
Three of the synthetic oil plants which escaped damage in American bombing raids will be converted to produce agricultural fertilizers. The once mystery-shrouded liquefaction plants at Ube and Takigawa are to produce ammonium sulphate, while the Rumoe plant of the Nippon Petroleum Co. in the Hokkaido will turn out urea fertilizers.

Considering Japan's huge capital investment in coal liquefaction, the plants made a poor wartime showing. In the year ended March 31, 1945—before the heavy raids began—the five largest of them, mostly operating on the Fischer-Tropsch plan, produced 88,000 bbl. of motor fuel, 1,500 bbl. of aviation gasoline, 190,000 bbl. of bunker oil, 19,000 bbl. each of gas oil and semi-diesel oil and 14,500 bbl. of lubricants. Seven smaller plants are credited with an aggregate annual output of 240,000 bbl. of various fuel oils.

NITRIC ACID PLANTS

Japan now has nine nitric acid plants with an aggregate capacity of 66,000 tons of 100 percent of acid, against an actual production of 85,000 tons in 1936, which made her runner-up with Germany and Italy, which produced 100,000 tons each. Sulphuric acid production, on the other hand, has not appreciably declined. There are now 120 plants as against 72 in 1937, and they are able to produce 2,400,000 tons by the contact proc-

You get all three essentials on time with this heat insulation service



CLOSE WORK, involving insulation of valve bodies, flanges, and flanged tees at the New Hampshire Gas and Electric Company, Portsmouth, N. H., was done neatly and quickly by Armstrong's Contract Service, Boston office. Exhaust header and piping were covered with a combination of high-temperature insulation and 85% magnesia, with sewed canvas jackets.

1. MATERIALS. Insulations of tested efficiency — a complete line covering every industrial temperature and condition—are used by Armstrong's Contract Service.

2. ENGINEERING. Armstrong's experienced staff is ready at all times to co-operate with you in writing specifications to meet every possible requirement, however unusual it may be.

3. WORKMANSHIP. Crews of trained Armstrong craftsmen, located in major industrial centers, apply your insulation in accordance with the best standards and practices to satisfy a rigid code of workmanship.

PROMPT SERVICE in meeting your heat insulation needs is an important advantage of Armstrong's Contract Service. Armstrong's skilled superintendents and trained mechanics are specialists in getting your job done in the shortest possible time. But quality is never sacrificed for speed. On all three essentials—materials, engineering, and workmanship—Armstrong follows through with scrupulous care, because it takes full responsibility for the entire job. Armstrong's Contract Service is located conveniently near you. Just phone any of the offices listed at the bottom of this page. Armstrong Cork Company, Building Materials Division, 3302 Concord Street, Lancaster, Pennsylvania.

ALBANY, N. Y. • ATLANTA, GA. • BALTIMORE, MD. • BIRMINGHAM, ALA. • BOSTON, MASS. • CINCINNATI, OHIO • CLEVELAND, OHIO
COLUMBUS, OHIO • DALLAS, TEXAS • DENVER, COLO. • DETROIT, MICH. • HARTFORD, CONN. • HOUSTON, TEXAS • INDIANAPOLIS, IND.
JACKSONVILLE, FLA. • KANSAS CITY, MO. • LOUISVILLE, KY. • MEMPHIS, TENN. NEW ORLEANS, LA. • NEW YORK, N. Y. • PHILADELPHIA, PA.
PITTSBURGH, PENNA. • PROVIDENCE, R. I. • RICHMOND, VA. • ST. LOUIS, MO. • TULSA, OKLAHOMA • WASHINGTON, D. C.

ess (1,400,000 tons in 1937) and 2,500,000 tons by the chamber process (4,000,000 tons in 1937).

Of the seven soda ash plants Japan had in 1937, four are in operating condition with a capacity of 830,500 tons. The remaining 24 electrolytic alkali plants (39 in 1937) have an aggregate capacity of 159,420 tons for caustic soda and 81,960 tons for liquid chlorine, compared with 600,000 tons of caustic soda capacity in 1937. The chlorine-recovering capacity of Japanese alkali plants always had been a closely-guarded secret, because of the potential use of chlorine in chemical warfare, and no comparable prewar figures are available.

Reflecting the persistence of the prewar policy of pushing calcium carbide output as a basis for synthetics (acetic acid, rubber, nylon, plastics, tanning materials, etc.), dispersion of plants, replacements and repairs, the industry now finds itself in comparatively good shape. Twenty-six plants with an over-all capacity of 348,000 tons today are in operating condition. Capacity in 1937 was 420,000 tons, second only to that of Germany. It is surprising to note that the Japanese government report to the allied authorities placed synthetic rubber production capacity at only 750 tons a year, further claiming that only 356 tons was produced since Pearl Harbor, but supplies of crude rubber probably were large.

DYESTUFF CAPACITIES

There are six celluloid factories left, capable of producing 8,660 tons. Production in 1937 was 14,227 tons. The dyestuff industry, largely converted to produce explosives during the war, took the most severe punishment of all branches of chemical manufacture. Present production ratings, compared with actual production in 1936, are:

	1945 Capacity Metric, Tons	1936 Output Metric, Tons
Basic dyes	200	937
Acid dyes	200	845
Direct dyes	800	2,847
Vat dyes	800	1,772
Mordant dyes	200	472
Sulphide dyes	5,400	12,100
Others	400	314

The loss in capacity is much larger than indicated in these figures because the industry reached its production peak in 1940 or 1941—but no figures are available.

The report puts the camphor refining capacity at 4,000 tons a year, which indicates a loss of one-third of prewar capacity. Many installations together with the sources of raw material were lost through the retrocession of Taiwan (Formosa), and natural camphor is therefore destined to bulk large in the trade of China. Incidentally, Japan surrendered several perfumery manufacturing plants, which turn out large quantities of aromatic camphor oil derivatives.

The Russian occupation of Sakhalien, once an important Japanese pulp and paper production center, might be expected to have whittled down Japan's paper-making capacity to a considerable degree. However, the Allied report discloses a surprising amount of new mill construction between 1939 and 1945 on the Japanese mainland. There are now 205 plants with 300 machines, compared with 53 plants and 203 machines in 1939. These have an over-all capacity of 1,640 million pounds, compared with 1,948 million pounds in 1939.

THE FAILURE OF "FACT-FINDING"

THE PRESIDENT has asked Congress to grant him authority to appoint fact-finding boards to deal with nationally important labor disputes. Most citizens would like to see some reasonable and objective solution of the industrial strife that now is disrupting reconversion. Unfortunately, the record of the "fact-finding" procedure indicates that any claim of impartiality for this process is a gross misrepresentation.

The Administration bill would authorize the President to appoint such boards in cases certified to him by the Secretary of Labor. Each board would report to the President "its findings of fact and such recommendations concerning the dispute as the board deems appropriate." Its facilities and staff would be provided by the Secretary of Labor. The bill provides for an interval of not more than 30 days known as a waiting or "cooling off" period during which it would be "unlawful" (though no penalties are specified) for anyone to promote or encourage work stoppages.

Because the Administration did not wait for Congressional action upon its proposal, but appointed a number of fact-finding bodies to deal with current emergency cases, we have been afforded at least a partial preview of how the procedure may be expected to work out if laws establishing it are passed.

If the reports handed down by the fact-finding panels in the General Motors and oil disputes may be regarded as representative, it can be stated conclusively that Government-appointed "fact-finding" boards will concern themselves to only a minor degree with the establishing of facts. A far greater share of their effort will be concerned with the speculative business of forecasting future output and production efficiency and appraising the "ability to pay" of the companies involved. But the predominant emphasis will be placed upon framing recommendations for settling the disputes in line with announced Government wage-price policy.

In short, the procedure essentially will be one of registering with the public a government opinion as to how far wages may be raised in the cases at issue without raising price ceilings. Both the General Motors and the Oil Panels stated, in quite explicit terms, that this was their conception of the job assigned them.

"Fact-Finding" in Auto and Oil Disputes

As the General Motors Panel phrased it: "This board subscribes to, and has been guided by, the national wage-price policy" — which it summarizes as calling for wage increases to maintain take-home pay at wartime levels, to the degree possible without inflationary price rises.

The Oil Panel was even more forthright in the statement of what it was supposed to do. "In the judgment of the panel," it declared, "the earnings of the workers must be as high as is consistent with both the maintenance of the stability of the price structure and the provision for reasonable returns to the owners of industry." In other words, prices and the return to investors are to remain fixed, with labor entitled to an ever-increasing return up to the limit of what the traffic will bear.

Having thus outlined their respective conceptions of the job, each panel proceeded to carry out its mission.

The Automobile Panel recommended that General Motors increase its basic hourly wage rates by 19½ cents, which amounts to about a 17½ per cent increase on the company's average hourly wage of $1.12. The Oil Panel recommended an 18 per cent increase in basic hourly wage rates, or an additional 21 cents to the average wage rate of $1.20.

The General Motors recommendation was based almost exclusively upon the Panel's calculation that a 19½ cent raise would keep weekly take-home pay equal to that earned in 1944 when the work-week averaged 45.6 hours. The calculation turned on an estimate of what the effective work-week was likely to be in 1946.

The Oil Panel's recommendation appears to have been based on a more complex but no more conclusive accounting. After calculating that the maintenance of July 1945 take-home pay after 40-hour shifts were restored would require a 22 per cent increase in straight-time hourly wages, it recommended that an 18 per cent increase be made. It accounted for 9½ per cent of this by noting that this was needed to cover cost-of-living rises, and explained that the rest was justified by a combination of factors including loss of premium overtime pay, higher productivity, and settlements already negotiated. Since the Panel gave no indication of the weight given to these several factors, it may not be unfair to assume that the last-named was given preponderant importance, since 18 per cent was the increase already granted in collective bargaining by Sinclair and certain other oil companies.

Higher Pay Without Higher Prices

Both panels stated that the pay increases recommended could be met without raising price ceilings, but neither documents its case on this score with very conclusive "facts".

The Oil Panel confined its observations on this account to the statements that only one company in its group had pleaded "inability to pay" and that the industry was in a generally profitable position during 1943 and 1944.

The Automotive Panel stated that, under a number of assumptions about the 1946 operations of General Motors which it believed to be valid, the Company would have higher earnings than it had in 1941, its previous record year. It specifically stated that its findings in the case were not applicable outside the

automobile industry, but it recognized that the General Motors settlement would more or less determine the settlements of other automotive companies. It stated that it had not been able to arrive at a clear conviction as to the ability of other auto makers to pay similar wage advances, but it dismissed the issue by observing that they could expect to operate at full capacity in 1946, and that this should provide savings to offset the increased wage expenditures.

From the management point of view, one of the most serious limitations in the panels' procedure was their failure to deal with any of the Company claims put forward. In ordinary collective bargaining the demands of both sides are advanced and concessions in one direction are traded for concessions in the other. Here, although the companies involved had insisted upon their need for guarantees against contract violations and wild-cat strikes, and for other union concessions, nothing but the wage issue was considered by the "fact-finding" bodies. The General Motors Panel specifically recommended that the wage increase of 19½ cents be granted, but that otherwise "the status quo prevailing before the strike be restored by the reinstatement of the 1945 contract between the parties." Handled thus, fact-finding becomes indeed a wholly one-sided exercise.

Both panels accepted, quite uncritically, the general position taken by Government spokesmen that wage increases are inflationary only if they are directly translated into price advances. It should be obvious that all wage increases add to the inflationary pressure, if made at a time like the present when consumer purchasing power far outstrips the volume of goods and services available to satisfy it.

"Fact-Finding" Dodged in Steel and Rails

It is ironic, too, that even while the Automotive and Oil Panel groups were holding the "government policy" line, the President and his Reconversion and Stabilization Directors were busily at work trying to dent it. In the steel dispute, although price rises in this industry have a particularly sharp inter-industry impact, hearings by the appointed fact-finding board were deferred while negotiations were carried forward by the President and his advisors under which the industry was offered a price increase of approximately $4.00 a ton on condition that U. S. Steel and the United Steelworkers agree upon a mutually acceptable wage boost. It is hard to avoid the cynical conclusion that wage increases constitute the major administration policy, and that the principle of not translating them into increased prices is sacred only in those cases where there can be some reasonably plausible showing that wages may be raised without price advances.

Much the same general conclusion — that the "facts" are controlling only if they support a substantial wage increase — is sustained by the history of the administration of the Railway Labor Act of 1926, often cited as a glowing example of how "fact-finding" by so-called Emergency Boards of Presidential appointees has served to prevent strikes on the railroads. It is true that reports of almost all of the 31 Emergency Boards appointed to look into threatened railway strikes in the 20 years since the act was passed have provided the basis for a settlement of the disputes in question. The fact — a real fact — remains, that in 1941 and again two years later the wage adjustments found appropriate by Emergency Boards in major railway labor disputes were revised upwards at the White House after the unions involved rejected them as unsatisfactory and threatened to strike. The second upward revision was made after government seizure of the railroads to prevent a national transportation tie-up. When the "facts" did not indicate a large enough wage increase to satisfy the union and the Administration, the "facts" went out the window.

It would be irresponsible to deny the importance of finding some tenable solution of current disputes that threaten to completely disrupt the reconversion process. But upon the evidence of experience, "fact-finding" boards cannot be expected to operate according to the common conception of their function — as agencies designed to sift out for the public an objective and significant weighing of the facts behind conflicting claims.

Without Principles Facts Mean Little

Facts, if they are assembled upon a sufficiently partisan basis, can be made to document almost any case one wishes to establish. The major difficulty in marshalling facts to resolve wage disputes is that there are no agreed-upon principles to determine the levels at which wages should be set. In the absence of such principles, it is inevitable that "fact-finding" boards, appointed by the Administration, manned largely by those who helped develop and administer Administration wage policies, and depending for technical assistance upon Administration Departments, will serve merely to implement Administration wage policy.

If Government means to reassert its wartime authority to fix wages — an objective specifically disavowed by the President and seemingly wanted by no one — it should accept the responsibility directly, rather than operate to that end through "fact-finding" boards which are independent in theory, but which cannot be so in fact.

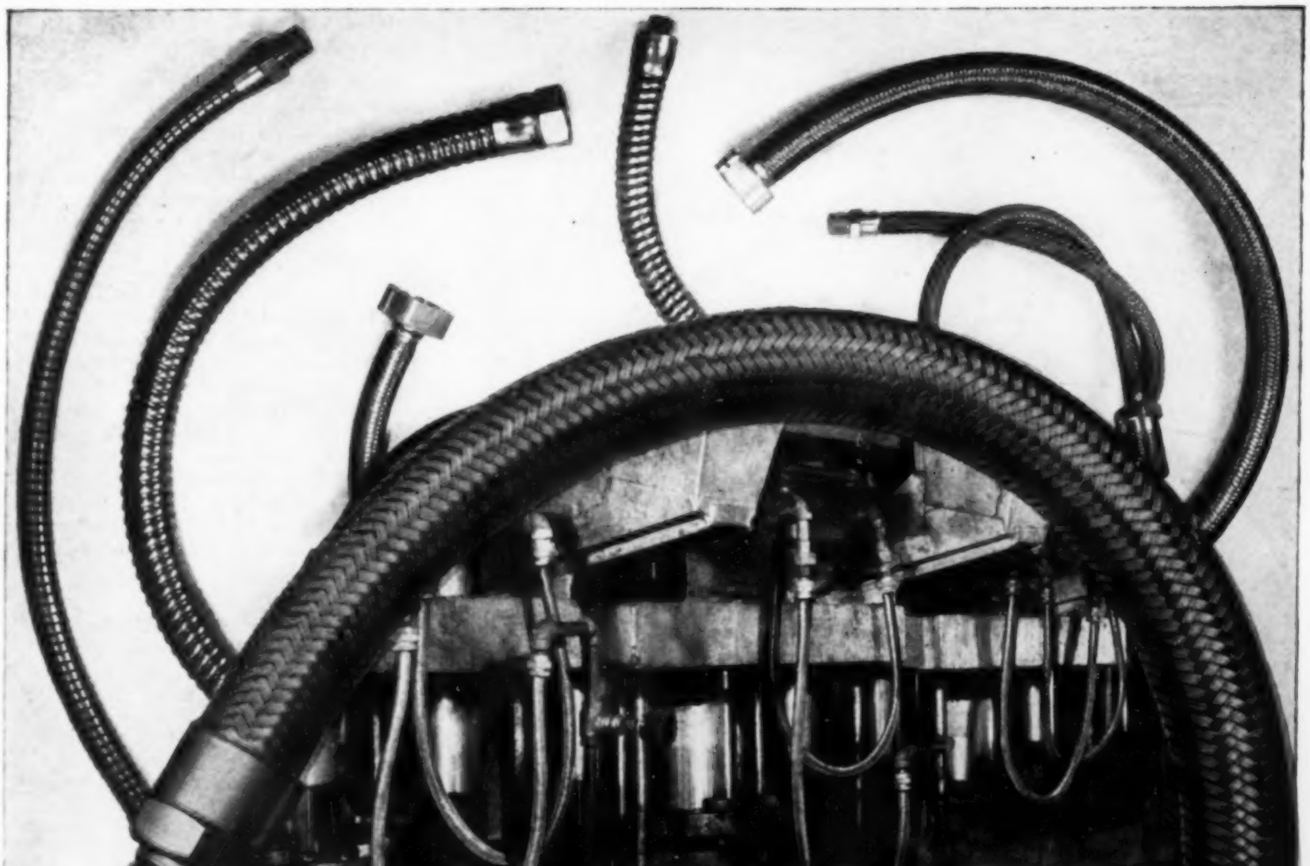
The failure of the brand of "fact-finding" now urged upon Congress by the President is evident. Therefore, we must look for a solution along other lines.

What is needed is for labor and management to agree upon the principles that should govern the determination of wages under free collective bargaining. When such agreement is reached, then and only then, can fact-finding become an objective and useful instrument for settling wage disputes.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Co., Inc.

THIS IS THE 44TH OF A SERIES



These "American" Seamless connections convey water at 370 degrees under 200 lb. pressure to the platens of a large modern plastic molding press.

Flexible...yet withstands High Pressure and Heat

A good example of the ability of American Flexible Metal Hose and Tubing to stand up in severe service is this use on a modern plastic molding press . . . where high temperature, pressure, corrosion and constant flexing combine to attack the connection.

In countless other applications "American" assemblies provide long, economical service. Carrying liquids, oils, grease, water, steam, gases and semi-solids, they absorb vibration, compensate for misalignment and allow for movement of parts.

An American Flexible Metal Hose or Tubing assembly can be engineered to meet practically any requirement. For detailed information, write for Publication SS-50.

ANACONDA *American* METAL HOSE

THE AMERICAN BRASS COMPANY

AMERICAN METAL HOSE BRANCH

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

SOUTH AFRICA MAY HAVE RADIOACTIVE ORES

Investigation is under way in South Africa into the possibility that the Witwatersand Gold Mine dumps may contain uranium. Unmined ore reserves and the dumps are thought to contain thousands of tons of the ore. Diamonds first gave the clue to radioactivity in the goldfields. A number of stones found had a greenish color which is a sign they had been exposed to radium rays. As early as 1923 the Chemical, Metallurgical and Mining Society at one of its meetings was told that a group of domestic mines carried a mineral known as uraninite, nearly one-half of which comprised a compound of uranium. From one mine, 300,000 tons of ore yielded 720 grams of radioactive concentrate. The concentrate contained 44 percent uranium oxide and 127 milligrams of radium. Should radioactive ore be found in the Union the government proposes to consider the basis on which it should be exploited.

CANADIAN COMPANY MAKES NEW APPOINTMENTS

Promotions and new appointments among officials of the Consolidated Mining & Smelting Co. of Canada, Ltd., Trail, B. C., were announced recently by R. W. Diamond, vice president and general manager of the company. P. F. McIntyre has been appointed manager of the newly created position which will bring the entire range of the company's personnel activities under his supervision. R. R. McNaughton has been made manager of the metallurgical division, another newly created position which places him in charge of all metallurgical operations. He is succeeded as chief metallurgist by A. D. Turnbull. F. C. Ransom has been promoted from acting superintendent to superintendent of the refineries and A. G. Robertson has been made assistant superintendent of that division. J. H. Hargrave has been appointed acting superintendent of smelters.

RUSSIA USES HYDROGEN TO COOL GENERATORS

Press reports from abroad carry the information that the Electrosila plant in Leningrad USSR, is using hydrogen instead of air as a cooling agent in the generators being built at the plant for the wrecked Dnieper dam. It is explained that this substitution was made because it will result in a saving of 20 percent in building materials and will double the productivity of the machine.

CHINA PLANS TO DEVELOP OIL REFINING INDUSTRY

The National Resources Commission of China, which maintains an office in New York, in its work toward the development of the petroleum industry in China, has entered into an agreement with the Universal Oil Co. of Chicago whereby that company will take part in this development. Two Universal Oil men, Dr. Gustav Egloff and W. B. Shanley, will visit China to make a preliminary study and to recommend steps to be taken to improve operations at existing refineries, to place in operation refineries now able to function,

to effect repairs to place damaged refineries in service, and to coordinate and expand refining facilities for present and future needs of China.

CHILEAN UNIVERSITY WANTS MANUFACTURERS' CATALOGS

Directors of the Universidad Tecnica Federico Santa Maria of Valparaiso, Chile, have requested that the university be furnished with catalogs, pamphlets, and prospectuses of the leading manufacturers in the United States handling machinery and technical equipment. Such material, in the past, has been available from Germany, Great Britain, and Sweden. The university is the leading technical school in the country and the directors wish to give the students an opportunity to study United States equipment and methods and believe manufacturers' catalogs and similar literature will give them a way for becoming acquainted with United States products.

CANADIAN RESEARCH GROUP IN NEW QUARTERS

The Canadian Research Institute recently acquired the building formerly known as St. George House at 46 St. George St., Toronto. The new quarters made it possible to expand and completely redesign the chemical laboratories. They now are divided into three major separate sections, research analysis, control, and physical testing. Development work on the applications of synthetic resins and plastics continue to constitute a large part of the work in this division closely followed by adhesives, paper products, and chemical specialties. Production of several lines of laboratory apparatus and electrical testers is scheduled for the near future.

SWEDEN EXPANDS PRODUCTION OF SUPERPHOSPHATE

Following out plans for an expansion of superphosphate production in Sweden, A/B Forenade Superfoffatsfabiker is now building a new plant at Norrkopping. It is estimated that the new plant will be able to produce about 100,000 tons of superphosphate a year. A sulphuric acid unit will be included in the plant.

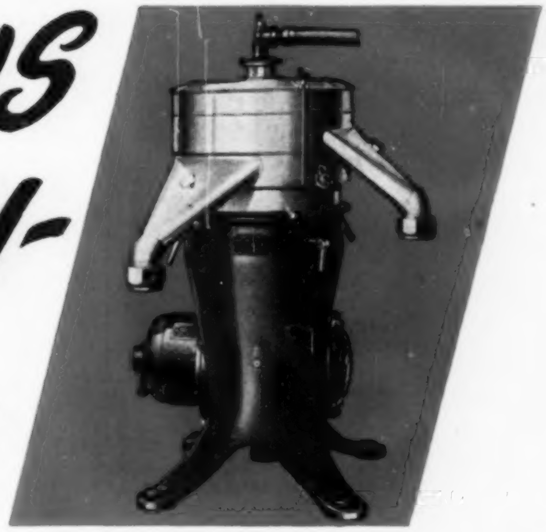
NEW TIRE AND TUBE PLANT FOR SOVIET UNION

Unofficial reports state that a new rubber tire and tube factory has been built at Moscow, Russia, and was expected to be in operation by the end of 1945. Details about the probable output were not given but the plant is to cover an area of 100,000 square meters.

URUGUAY TO INSTALL NEW ALCOHOL DISTILLERY

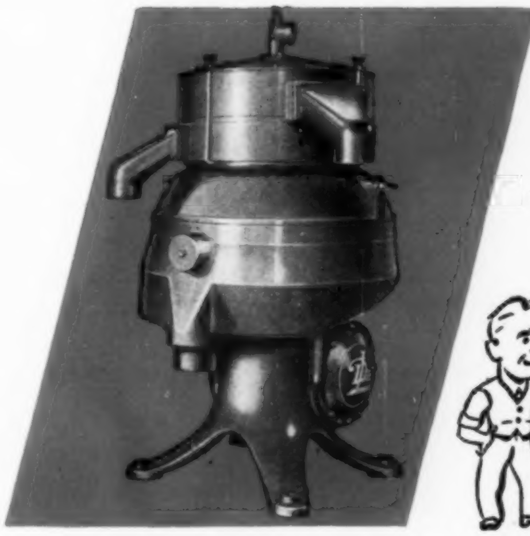
An alcohol distillery with an estimated annual capacity of 6,000,000 liters will be established at Paysandu, Uruguay, by the Administracion Nacional de Combustibles Alcohol y Portland. It is the first of a series to be installed in various agricultural sections. Equipment will be supplied by a United States company.

CONTINUOUS SEPARATION-



Quicker ? Yes!

BUT A BETTER PRODUCT, TOO!



DE LAVAL Industrial Centrifugals are usually installed to speed up the process of separating two liquids or clarifying one or two liquids. By employing centrifugal force, they make straight-line production possible, accomplishing in seconds work which by gravity or other outmoded methods might take minutes or even hours. Thus, speed of separation is admittedly a prime reason for using De Laval Separators.

Another advantage is inherent in the higher separating force obtainable with the centrifuge. Certain emulsions are difficult, if not impossible to break by gravity or filters, but can be broken in a De Laval machine. And usually, if not invariably, the De Laval method will yield a *better* product — cleaner, drier, or more highly concentrated.

When continuous three-way separation is desired, the De Laval "Nozzle-Matic" is available. The capacity of the "Nozzle-Matic" varies from 400 to 6,000 or even more gallons per hour, depending on the nature of the liquids being separated and the amount of solid impurities present in one or both of them.

Whatever the application for centrifugal force, there is a wide range of De Laval machines in many types and sizes from which to choose. Write for Bulletin No. 225.

DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

CENTRIFUGAL PROCESSING SYSTEMS

GERMAN CHEMICAL INDUSTRIES

DDT AND GIX

Geserol is the trade name used by I.G. for DDT and Fluor-Geserol refers to difluordiphenyltrichlor-ethane in which two fluorine atoms take the place of two chlorine atoms in the benzene nuclei.

I. G. have preferred to use DDT in emulsion form rather than as a powder and because of its relatively high melting point they claim to have had difficulty in preparing satisfactory emulsions. One attempt to avoid this trouble had been to make an impure product deliberately in which side reaction products were left behind to lower the melting point. It has been found, however, that a still greater lowering of melting point, and a much better product for emulsification could be made if fluorbenzene replaced chlorbenzene in the condensation. Also, it was thought that the resulting product had improved insecticidal properties, particularly against mosquitoes.

Fluor-Geserol is also known in the factory as Gix. Gix is made at I. G. Hochst, aniline is diazotized in the presence of copper and hydrofluoric acid to give the phenyldiazonium fluoride which splits out nitrogen to give fluorbenzene. From this point the process is similar to DDT using fluorbenzene in place of chlorbenzene. Gix is 7 times better than Geserol (DDT) on flies but costs 10 times as much.

Digest from "I.G. Farbenindustrie A.G. Plant, Hoechst/Main" OPB Report No. 183 by P. J. Leaper, and "Manufacture of Insecticides, Insect Repellents, Rodenticides—I.G. Farbenindustrie A.G., Leverkusen and Elberfeld" OPB Report No. 240 by J. E. Smadel and F. J. Curtis.

POLYETHYLENE

Investigation of the polymerization of ethylene was started at Ludwigshafen in 1938. Two types of polymers were produced: Lupolene N, a low molecular weight product and Lupolene H, a high molecular weight product.

Lupolene N is a waxy polymer, melting point 105-108 deg. C., 2,000-3,000 molecular weight, $K = 20$.* It is made by polymerizing in methanol at 200 atm. pressure, using benzoyl peroxide catalyst.

Lupolene N is used primarily for addition to Oppanol B 150 and B 200 (polyisobutylene of molecular weights 150,000 and 200,000), with which it is compatible in all proportions, to make rolling and calendering easier. Ten percent of the wax reduces cold flow and improves the tensile strength of the Oppanol film. Lupolene N also finds application as a constituent of shoe, floor and furniture polishes. The wax is mixed with paraffin of 50-52 deg. C. melting point as an extender and is dissolved in Fischer-Tropsch naphtha.

Lupolene H is a high molecular weight (15,000-20,000) polyethylene, $K = 65$* (in 0.2 percent solution in decalin), melting point 115-116 deg. C. It is made by polymerization of ethylene without solvent at 2,000 atm. pressure with a controlled amount of oxygen as catalyst.

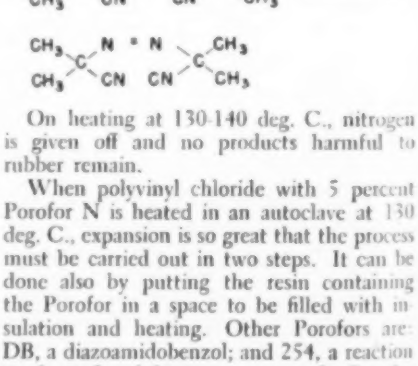
Lupolene H is thought to be somewhat crosslinked as compared to the British Polythene, which is a straight chain polymer and has better solubility in benzene. The power factor is 0.005, which has led to its use in high-frequency insulation, radar equipment, and submarine cable. Films for condenser dielectrics have been made experimentally on hot rolls to 0.1 mm. thickness and by melt extrusion to 0.05 mm. thickness. Gelatin emulsions will not adhere to the polyethylene film. Experimental work has also been conducted on spray-coating the powdered material and on its use in film form as a heat-sealing wrapping material. Lupolene H has been incorporated with polyisobutylene to the extent of 10 to 20 percent to improve the tensile strength of the latter material. It has also been formed into various articles by compression and injection molding.

* K is a measure of molecular weights of vinyl chloride polymers. For definition of this empirical value see *Chem. & Met.* Dec. 1945, p. 180.—Editor.

Digest from "Plastics in Germany 1939-1945" OPB Report No. 8 by G. M. Kline.

POROFOR N

Porofor N is a product soluble in buna which gives nitrogen during vulcanization to make a foamed rubber with extremely fine and regularly sized pores far superior to ordinary foamed rubber. Such foamed rubbers were used by the Germans in airplanes and submarines for dish holders, swimming vests, insulation, etc., and could be made in any desired shape. Specific gravity of the product is 0.2 to 0.6. The product (with a yield of 78 percent of theory) was made as follows:



On heating at 130-140 deg. C., nitrogen is given off and no products harmful to rubber remain.

When polyvinyl chloride with 5 percent Porofor N is heated in an autoclave at 130 deg. C., expansion is so great that the process must be carried out in two steps. It can be done also by putting the resin containing the Porofor in a space to be filled with insulation and heating. Other Porofors are: DB, a diazoamidobenzol; and 254, a reaction product of cyclohexanone as per the Porofor N process.

Digest from "Miscellaneous Chemicals, I. G. Farbenindustrie A.G., Elberfeld and Leverkusen" OPB Report No. 200 by F. J. Curtis and M. F. Fogler.

FOAMED COAL

The principal features claimed for the foamed coal were its high reactivity and permeability that were said to be due to its finely porous and capillary structure. The fuel, having these characteristics, was claimed to be particularly suitable for use in stationary and vehicular gas producers, in gas engines and rockets, in hydrogenation process for the production of liquid fuels, and in the manufacture of chemical products.

The fundamental features of the invention

comprise wetting any coal, screened to from 0.2 to 1.0 mm., with 4-10 percent of a thermosetting resin such as phenolic resin. The resin upon setting binds the coal particles together into a cohesive mass having interstitial voids, and at the same time preserving the original bulk density. Waste smalls or fines from any coal were considered to be suitable for manufacturing foamed coal. This would permit utilizing great above-ground reserves of such material that heretofore has been colliery waste.

A variety of subsidiary details for improving or imparting special properties, as firmness, reactivity, etc., to foamed coal was described or claimed. These included the introduction of activators like alkaline earth carbonates, iron oxide, and oxygen carriers like pyrolusite and potassium perchlorate. Another claim was the production of specially ignitable product which included some of the constituents of gunpowder with the coal.

Digest from "Interrogation of Drs. Julius Schmitt, Ludwig Schmitt, and Heinrich Schmitt, of Dr. Heinrich Schmitt-Werke, K.G., Berchtesgaden" OPB Report No. 376 by D. S. Fraser, J. P. Jones, R. A. A. Taylor and F. A. Williams.

AMMONIA SYNTHESIS

The Leuna Works of I.G. produces a number of products from the gases resulting from brown coal processing. Among the important products is synthetic ammonia. This operation is intimately dovetailed into the plant operations, and, as a result, was not assembled as a complete unit. The capacity of Leuna is given in as 2,000 metric tons NH_3 per day. Coal analysing 53 percent H_2O, 6 percent ash is mined by open pit operations 5 mi. from the plant.

A number of gases are used, but, in the main, the process resembles the usual producer gas and water gas operation, the CO being converted to CO_2 by iron oxide catalyst. CO_2 is removed by water at 25-30 atm. and a gas results which is composed of 1 volume N_2 and 3 volumes of H_2. About 3 percent CO remains which is treated with cuprous ammonia solution at 240 atm. If the mixture is incorrect, it is adjusted by addition of N_2 from a Linde liquid oxygen plant. Such additions are made before the cuprous scrubbing.

The new gas goes into the circulation system between the catalyst converter and the water cooler. At this point the gas is 150 deg. C, and 10-14 percent NH_3. Introduction at this point enables the removal of impurities in condensation of the ammonia. The quality of product is lowered by water and other impurities. The gas is cooled by water in concentric pipe coolers, the water being outside and arranged for counter flow. The river water varies from 1 deg. C. to 22 deg. C. Cooling is to about 15 deg. C. above water temperature, largely due to dirty water fouling the surface. Such tubes are cleaned with difficulty. The gas leaves the water cooler, then passing to a cold exchanger, which cools to 0 deg. C., then to a refrigerator cooled by boiling NH_3 at 0.4 atm. which is in a separate refrigeration system. This cools to -20 deg. C, and strips the 10-14 percent gas to 3 percent NH_3; the condensate falling to a flask for withdrawal. The remaining gases go to the above cold exchanger and are reheated to $+10$ deg. C, thence to the circulating pump, which discharges to the catalyst con-

verter bomb. This is the standard Haber flow.

The catalyst converting bomb is 800 mm. inside diameter and 12 m. long and has capacity of 30 tons NH_3 per day. It contains 6 tons of catalyst (440 lb. catalyst per ton NH_3 per day). The catalyst occupies 9 of the 12 cu.m. and the interchanger of the catalyst 2½ m. All internal parts of the bomb are made of S-2 steel.

In the catalyst the gases from the circulating pump (10 deg. C.) go in the top, pass down the inner wall (keeping it cool), up around the tubes of the exchanger where it is heated to 400 deg. C., then going up around the tubes in the catalyst body for further preheat and down the central well containing an electric heater, which is used if necessary to maintain 500 deg. C., thence up around the central tube, and then down through the tubes containing catalyst (temperature slightly above 500 deg. C.) The gas now containing 10-14 percent NH_3 passes down through the preheater tubes and out at 150 deg. C.

Catalyst research is done at Oppau where many tests have been made. Very few tests were made at Leuna and the cataylst analyzes (stated) 0.5 percent K; 2.5 percent Ca, balance iron. Pure iron is used in fine state, the K is added as the nitrate, and the Ca as lightly burned lime. The iron is melted by burning with O_2 till melted, the accelerators are mixed, cooled, crushed, and sized. Life varied from 100 days to three years.

Digest from "I.G. Farbenindustrie A.G., Leuna Nitrogen Fixation Plant" OPB Report No. 199 by R. M. Hunter.

ACETIC ANHYDRIDE

Acetic anhydride was made by the vapor phase, catalytic, dehydration of acetic acid. Triethyl phosphate was used as a catalyst. The process is carried out in two steps.

Acetic acid was fed to a vaporizer made of V4A and heated with steam coils. The acid was vaporized under a pressure of about 200 mm. Hg abs. The vapors passed through the catalyst vaporizer, a horizontal, steam jacketed V4A tube, to which was fed liquid triethyl phosphate.

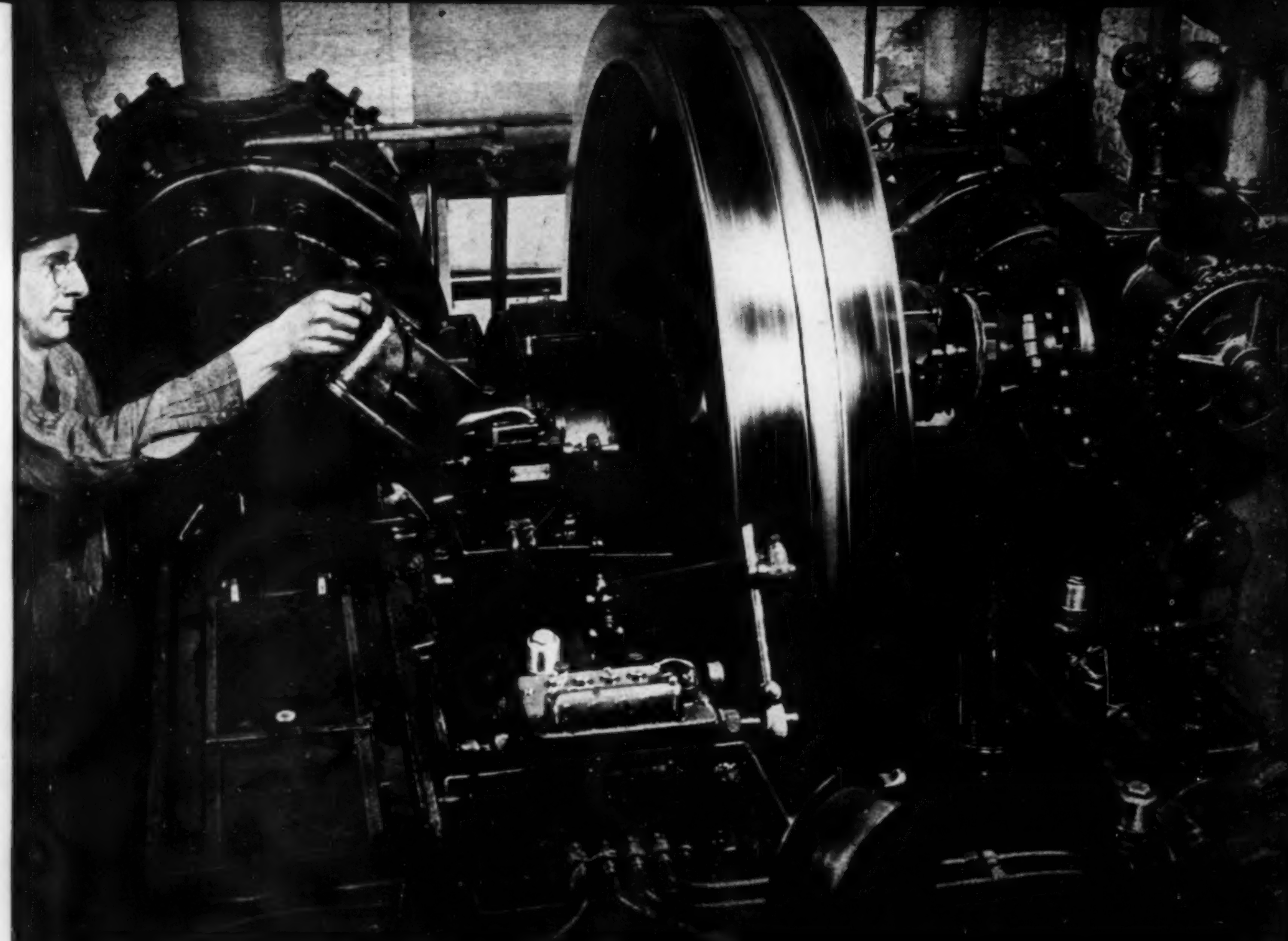
Mixed vapors passed through a preheater and cracking furnace, which consisted of coils of Sichromal tubing heated in electric resistance furnaces or gas fired. Gases emerged from the preheater at 600 deg. C. and from the cracker at about 700 deg. C. A small amount of ammonia is added at the exit from the cracker to inhibit the reversal of the ketene reaction.

The coils in the preheater and especially in the cracker became caked with a very hard carbon. They were turbined twice a year. The triethyl phosphate catalyst heated in the presence of carbon formed elemental phosphorus. When this carbon was blown from the tubes it therefore ignited spontaneously and due precautions were taken.

Hot gases from the cracking furnace were cooled in four V4A coolers, the first two of which were water cooled and the last two brine cooled.

The effluent from the coolers passed to a separator from the top of which the uncondensed ketene passed to the second part of the system. Dilute acetic acid (35 percent) flowed from the bottom of the separator.

The entire system, including the equipment for the final distillation, was kept full



COMPRESSOR SPEEDED-UP 20%

SUN COMPRESSOR-LUBRICANT . . .

Reduces Spring- and Valve-Breakage, Ends Shutdowns Due to Hard Carbon

When a compressor-overhaul puts a whole plant off stream, then it's vital to keep it running. Here's a case where correct compressor-lubrication meant the elimination of frequent interruptions . . . plus savings of over $400 a year on maintenance.

A large plant was stumped by the problem of lubricating a compressor, rated at 600 r.p.m., but running 24 hours a day at 720 r.p.m.

Hard carbon formed, and springs and valves were being broken at the rate of more than 160 a year.

A Sun Engineer was called in and recommended a Solnus Oil. In eleven months with this new oil, only six springs and valves broke.

These results are typical of Sun performance throughout the chemical industry. A telephone call to the nearest Sun office will put one of the country's greatest service-organizations to work in your plant. Or write direct to . . .

SUN OIL COMPANY • *Philadelphia 3, Pa.*

Sponsors of the Sunoco News-Voice of the Air—Lowell Thomas

SUN
SUNOCO
INDUSTRIAL
PRODUCTS

of nitrogen at all times to prevent acetic acid attack on the copper and consequent discoloration of the product.

Ketene gas from the separator passed through a copper scrubber through which a mixture of anhydride 85 percent and acetic acid 15 percent were pumped at 30-40 deg. C. Vapors passed from the top of this scrubber to the bottom of a second scrubber. Liquids flowed to the raw anhydride storage tank.

In the second scrubber, more ketene was removed from the gas by scrubbing with a mixture of 10-20 percent anhydride with 80-90 percent acetic acid at 20 deg. C. The scrubbing liquor was recycled with a V4A pump. Fresh acetic acid was added to this cycle and the scrubbing liquor for the first scrubber is taken from it.

In the third scrubber the gases are scrubbed with raw anhydride at 0 deg. C. and in the fourth scrubber with 35 percent acetic acid at 0 deg. C.

Stripped gases, a mixture of methane, ethylene, carbon monoxide, carbon dioxide, etc., went to a vacuum pump and were discarded. The operating pressures in the system were on a gradient between approximately 200 mm. Hg abs. at the acetic acid vaporizer and 80 mm. Hg abs. at the vacuum pump.

Raw anhydride could not be run to concentrations above 85 percent without turning brown due to the presence of unreacted ketene. It was concentrated to 95 percent by batchwise fractionation in copper equipment. The raw anhydride contained traces of compounds formed by decomposition of the catalyst which when boiled with the anhydride turned brown. They were removed as the still residues from the final distillation which amounted to 3 percent on the pure anhydride.

The heating coils in the still were boiled out with caustic soda solution after every 8-10 distillations to clean off the resinous cake. Large heat transfer surfaces in the still were desirable as they reduced caking.

Yields were 80.5 kg. of 95 percent anhydride per 100 kg. of 100 percent acetic acid.

Digest from "Dr. Alexander Wacker Gesellschaft fur Elektrochemische Industrie, Burghausen, Germany" OPB Report No. 208 by V. C. Bidlack, F. J. Curtis and J. M. Harris.

POLYVINYLIDENE CHLORIDE

Experimental work has been under way at Ludwigshafen and Wolfen on production and use of polyvinylidene polymer for bristles but only mediocre results have been obtained. This may be attributed to the lack of the special nickel alloys required for the machinery used in its fabrication. A 50-ton per month monomer plant has been built at Schkopau. Various copolymers have been produced at Ludwigshafen, including 90:10, 85:15, and 80:20 proportions of vinylidene chlorides: vinyl chloride. Known as "Dichlorid" or "Diorid," 18 tons of a compound containing 84 vinylidene chloride, 15 vinyl chloride, and 1 acrylonitrile were made in 1942 at a cost of 3.53 marks per kg. Polyvinylidene chloride: vinyl chloride copolymer is known as Igelit PC 120 at Wolfen. It is expected to replace Igelit PC as a more economical product.

Digest from "Plastics in Germany 1939-1945" OPB Report No. 8 by G. M. Kline.

CORROSION FORUM

EDMOND C. FETTER, Assistant Editor

MODERN MATERIALS • MODERN METALS

WARTIME PROGRESS IN MATERIALS OF CONSTRUCTION

KEYNOTE of this issue of *Chem. & Met.* is Chemical Engineering Progress for Peace—War's Most Promising Byproduct. In keeping with this theme there is presented here a thumbnail summary of the past five years in materials of construction.

Back in the twenties and early thirties the big developments in materials of construction were primarily in metals and alloys, particularly the stainless steels. In recent years, however, the greatest number of innovations have come in the field of non-metallics, such as synthetic rubber, glass and plastics. Only a half dozen years ago synthetic rubber and plastics, with a few exceptions like neoprene and phenol formaldehyde resins, were hardly recognized as candidates for chemical plant construction. Today there are dozens of them clamoring for attention.

RUBBER AND PLASTICS

Of the synthetic rubbers, GR-S was produced in by far the largest quantities and was indeed a "life saver" during the war as an alternate for natural rubber in chemical plant equipment. Experience has shown that, with a few minor exceptions, GR-S can be installed in any service where natural rubber has been used successfully. Both hard and soft compounds have been developed and employed as coatings and molded parts. However, in spite of its good war record, GR-S, because of its price and because it is more difficult for rubber manufacturers to process, is almost certain to lose out in the equipment field when natural rubber is again freely available. Postwar use of synthetic rubber is expected to be confined to applications involving oils, solvents, or heat, and the rubbers employed will be those developed for these purposes even before the war, that is, buna-N, neoprene, butyl, and Thiokol. The new silicone rubber should also be kept in mind as a high-temperature specialty.

Among plastics, the phenolics and vinyls have come to dominate the field in chemical equipment. Both are prewar types, but the last few years have seen them emerge in many new guises. A phenolic resin, for example, has been used as the impregnant for "compregnated" wood from which excellent fan blades are made. And vinylidene chloride, in the form of Saran pipe, has caught on with great success since it first appeared nearly four years ago. Both resins have been widely used as the basis for protective coatings.

There are other plastics that show excellent promise and in time they may become as important as the two just mentioned. To date, however, chemical plants have had little experience with them, either because they were too new or were too much in demand for other phases of the war program. In this group are nylon, silicones, polystyrenes, polyethylene, and acrylic resins.

GLASS AND WOOD

Glass as a material of construction has done considerable branching out. Glass wool is being used as tower packing. A phosphate glass is on the market for hydrofluoric acid resistance. Tempered plate-glass tanks are available which are resistant to thermal shock; the sides and bottom of this tank are notch-and-gasket joined and held together with Monel tie rods. Two improved techniques for field joining of glass pipe have been developed and neither requires the services of skilled glassworkers. In the first method, a bead is formed by spinning the pipe end in a ring burner and to this a standard flange can be attached; in the second, a standard conical flange is fused directly to the pipe by the successive application of gas and high-frequency induction heating.

Even wood, the oldest of all materials of construction, has undergone some face lifting. Impregnation with resin solutions, usually phenol formaldehyde, provides good chemical and mechanical strength for such objects as the fan blades already mentioned. Plywood too has found application in chemical equipment and though somewhat more costly than solid wood, it is frequently worth the difference when strength, permeability and warping are considered.

METALLICS

To this point we have mentioned only the non-metallics, but it should not be assumed that such materials have had the whole show. Only last month it was announced that a heat treatable, precipitation hardening stainless steel of the 18-8 type had been developed for such articles as bearings and valve parts where corrosion resistance and hardness are required. Another alloy, a 9-percent nickel steel, which was originally developed for high-pressure, low-temperature applications, is now being advanced as a corrosion resistant alloy for the chemical industries. And an electroplating and cold drawing process has been devised which makes it possible to line steel pipe with a thicker, denser coating of nickel or other metal than has heretofore been possible by electroplating methods.

CORROSION NEWS BRIEFS

A SYMPOSIUM on atmospheric corrosion of non-ferrous metals and alloys will be one feature of the Spring Meeting (Feb. 26 and 27) and Committee Week (Feb. 25 to March 1) of the American Society for Testing Materials, Hotel William Penn, Pittsburgh. The symposium will be held in two sessions in the afternoon and evening of Wednesday, Feb. 27. Among the committees which will meet during the week are A-5 on Corrosion of Iron and Steel, and B-3 on Corrosion of Non-Ferrous Metals and Alloys. Program for the symposium is as follows:

"The Corrosion of Rolled Zinc in the Outdoor Atmosphere," E. A. Anderson, New Jersey Zinc Co.
"The Behavior of Nickel and Monel in Outdoor Atmospheres," W. A. Wesley, International Nickel Co.
"Resistance of Copper Alloys to Atmospheric Corrosion," A. W. Tracy, American Brass Co.
"Use of Lead and Tin Outdoors," G. O. Hiers, National Lead Co.
"Resistance of Aluminum-Base Alloys to Atmospheric Exposure," E. H. Dix and R. B. Mears, Aluminum Co. of America.

EIGHT corrosion papers will be presented on the morning of Thursday, April 11, as one session of the National Meeting of The Electrochemical Society, Tutwiler Hotel, Birmingham, Ala., April 11-13 (not April 10-13 as announced earlier by the Society). Papers to be presented are as follows, and with the exception of the last, all have already been preprinted by the Society.

"Corrosion of Steels in Marine Atmospheres," C. P. Larrabee.
"Corrosion by Phenol at High Temperatures," A. Wachter and N. Stillman.
"Pipe Service Tests on Baltimore Water—Pitting of Black and Galvanized Wrought Iron and Steel Pipe Carrying Cold Water, Hot Water, and Returning Condensate," Charles F. Bonilla.
"Corrosion and Biofouling of Copper-Base Alloys in Sea Water," C. L. Bulow.
"Relationships Between Corrosion and Fouling of Copper-Nickel Alloys in Sea Water," F. L. LaQue and Wm. F. Clapp.
"Theory of Stress Corrosion Cracking of Mild Steel in Nitrate Solutions," J. T. Waber, H. J. McDonald, and B. Longtin.
"The Comparative Effect of Carbon and Nitrogen on Intergranular Corrosion of 18-8 Stainless Steel," H. H. Uhlig.
"Calgon as a Corrosion Inhibitor for Ottawa Tap Water," Morris Cohen.

NATIONAL Association of Corrosion Engineers will hold its 1946 annual convention in Kansas City, Mo., May 7-9.

DEVELOPMENT of Stainless-W, a new heat-treatable stainless steel of the 18-8 type, has been announced by Carnegie Illinois Steel Co. Stainless-W is a precipitation hardening alloy; solution annealing puts the hardening constituents (principally titanium)

into austenitic solution, and this transforms into supersaturated ferrite on cooling to room temperature. Subsequent reheating causes the hardeners to precipitate out of the ferrite and impart the desired increase in strength and hardness. The alloy is magnetic. Projected applications consist of those cases requiring hardness plus corrosion resistance, as in cams, rollers, bearings, and valve parts in the chemical, food, and oil industries.

CORROSION LITERATURE

Chemistry in Aircraft Maintenance. 28-page, illustrated booklet published by Turco Products, Inc., 6135 South Central Ave., Los Angeles 1, Calif.:—Prepared originally by the editors of Air Tech magazine. Deals with the practices of the aviation industry in corrosion prevention, paint removal, preparation of aluminum surfaces, engine overhaul, surface coatings, and the cleaning of transparent plastics.

Cooperative Research. E. A. Schoefer, *Corrosion and Material Protection*, Dec. 1945, pp. 6-8, 12:—History of the Alloy Casting Institute program at Battelle Institute, which for eight years has been systematically investigating the characteristics of corrosion and heat resistant alloys.

Corrosion as Encountered on Naval Aircraft and Methods of Prevention. *Corrosion and Material Protection*, Dec. 1945, pp. 9-12.

Stress Corrosion Cracking of Mild Steel, Part II. James T. Waber and H. J. McDonald, *Corrosion and Material Protection*, Dec. 1945, pp. 13-16, 18.

Correlation of Mechanical Properties and Corrosion Resistance of 24S-Type Aluminum Alloys as Affected by High-Temperature Precipitation. W. D. Robertson, AIME *Metals Technology*, Oct. 1945, 12 pp.

Diffusion of R301 Alloy (Aluminum) and Its Effect on Corrosion Resistance. L. F. Mondolfo, AIME *Metals Technology*, Dec. 1945, 13 pp.

First Electrodeposition of Metals for Corrosion Resistance. S. G. Bart, *Chemical Industries*, Jan. 1946, p. 51:—Describes method for electrodepositing a nickel lining in steel or cast iron pipe.

The Importance of Surface Cleaning for Metal Finishing. G. W. Seagren, *Corrosion and Material Protection*, Jan. 1946, pp. 6, 7, 21-23.

Welding and Annealing Stainless Steels. H. C. Esgar, *Western Metals*, Nov. 1945, pp. 13-15:—Detailed discussion of preferred procedures for flash, spot, resistance, and metal-arc welding of the austenitic, ferritic and martensitic stainless steels.

The Corrosion of Metals *Corrosion and Material Protection*, Jan. 1946, pp. 10-12, 23 (reprinted from *Nature*, Oct 13, 1945) —Summary of the addresses given at the summer meeting of the London and Home Counties Branch of the British Institute of Physics. Talks were apparently of the lecture, rather than the new information, type and dealt with electrochemical corrosion,

HAMER PLUG VALVES
Speed "Traffic" through your lines because
HAMER
PLUG VALVES
NEVER STICK!
Under the toughest service conditions—extremes of temperature, handling viscous, sticky fluids—Hamer Plug Valves always operate instantly, no matter how long the interval between operations. That's because the plug adjusting nut under the plug head, gives **positive turning** under all conditions . . . an exclusive Hamer feature.
Hamer All-Steel, Flanged, Balanced Type Plug Valve. Bar operated. 600 lbs. Working Pressure; 1200 lbs. Test Pressure. Suitable for varied industrial services where a lubricated or non-lubricated valve is required.
HAMER
STEEL
HAMER OIL TOOL COMPANY • 2919 GARDENIA AVENUE • LONG BEACH 7, CALIFORNIA

factors controlling corrosion reaction rates, personnel and activities of Corrosion Committee of the British Iron and Steel Institute, an apparatus for taking electrochemical measurements, corrosion of lead sheathing of buried telephone cables, and corrosion of wires in telephone exchanges.

Stress Corrosion Cracking of Mild Steel, Part III. *Corrosion and Material Protection*, Jan. 1946, pp. 13-19.

The Chromate Passivation of Zinc. S. G. Clarke and J. F. Andrew, *The Industrial Chemist*, Oct. 1945, pp. 549-554:—Describes an investigation into variations in the protective value of the film resulting from variations in the passivation process.

Industrial Plant in Glass. P. H. Turpin, *The Chemical Age*, Sept. 29, 1945, pp. 285-288:—Describes large-size glass equipment developed during the war, and enumerates applications and permissible service conditions.

Materials of Construction in the Petroleum Industry. T. M. Jasper, American Society of Mechanical Engineers, Advance copy, Nov. 1945:—Review in very broad and general terms of problems encountered and materials employed in petroleum production, refining, transportation, and storage.

Resistance of Nickel-Containing Alloys to Corrosives Encountered in the Petroleum Industry. B. B. Morton, American Society of Mechanical Engineers, Advance copy, Nov. 1945:—Detailed outline of corrosion problems encountered in refineries. Suggests applications for nickel-bearing alloys.

Electrolysis Surveys on Underground Cables. L. J. Gorman, *Corrosion*, Dec. 1945, pp. 163-177:—Explains at considerable length the methods employed by the Consolidated Edison Co.

The Behavior of Zinc-Iron Couples in Carbonate Soil. T. H. Gilbert and Guy Corfield, *Corrosion*, Dec. 1945, pp. 187-191:—Presents data obtained by measuring periodically the potential and current flow of some zinc-iron couples buried by the Bureau of Standards near Los Angeles.

Control of Pipe-Line Corrosion—A Manual, Part I. O. C. Mudd, *Corrosion*, Dec. 1945, pp. 192-218:—A lucid and comprehensive treatise on the present state of knowledge and methods. Part I covers theory of corrosion, types of corrosion, and methods of corrosion investigation.

Corrosion Protection by Phosphatization—A Review. Michael A. Streicher, *Corrosion*, Dec. 1945, pp. 219-227.

Improved Steels for High Pressure-Temperature Power Piping. J. J. Kanter, *Valve World* (published by Crane Co.), Dec. 1945, pp. 119-129:—Nature and occurrence of graphitization and progress to date in overcoming it.

Investigation of a Type of Failure of 18-8 Stabilized Stainless Steel. Walter Kahn, Harold Oster, and Richard Wachtell, American Society for Metals, preprint 15,

1945, 17 pp.:—Deals with high temperature failure of stainless steel in aircraft exhaust systems caused by carburization of the steel beyond the capacity of the stabilizing element to absorb carbon.

The Corrosive Action of Benzole Absorption Oils. C. M. Cawley and H. E. Newall, Society of Chemical Industry *Journal*, Oct. 1945, pp. 285-290:—Reports an investigation of corrosion in benzole absorption plants and concludes that chief cause is action of ammonium thiocyanate.

Corrosion in Hydrofluoric Acid Alkylation. M. E. Holmberg and F. A. Prange, *Ind. and Eng. Chem.*, Nov. 1945, pp. 1030-1033:—Tells where various metals and alloys were used in the HF alkylation plant and how well they performed.

Development Work to Prevent Corrosion. B. B. Morton, *Petroleum Engineer*, Nov. 1945, pp. 134, 137, 140, 142, 144:—How to approach a research and development project. Outlines the manner in which several corrosion resistant products were developed for the petroleum industry.

Formaldehyde as an Inhibitor of Corrosion Caused by Hydrogen Sulphide. P. L. Menaul and T. H. Dunn, *Petroleum Technology*, Jan. 1946, 9 pp.:—Describes highly successful use of formaldehyde in West Texas producing wells. A development of Stanolind Oil & Gas Co. (History of development and interpretation of above AIME paper, *Oil and Gas Journal*, Oct. 27, 1945, pp. 84-46.)

Controlling Corrosion in Refineries Processing Sour Crudes. W. H. Creel, *Oil and Gas Journal*, Oct. 20, 1945, pp. 132, 133, 137, 141:—A review of present practice in the application of metals and alloys.

Transformation of Iron by Bacteria in Water. R. L. Starkey, American Water Works Assn. *Journal*, Oct. 1945, pp. 978-983.

Assessing Wear Due to Friction and Corrosion. Phillip M. Fisk, *Iron Age*, Oct. 25, 1945, pp. 65-67:—Investigation of sheet metal hinges. Gives design details of testing apparatus.

Reaction Rate of Hydrogen Chloride and Sulphide with Steel. C. F. Prutton, D. Turnbull, G. Dlouhy, *Ind. and Eng. Chem.*, Nov. 1945, pp. 1092-1097.

Fundamentals of Science Relating to Electroplating. *Metal Finishing*, Oct. 1945, pp. 410, 411, 439:—Elementary discussion of the various types of corrosion, i.e., chemical, electrochemical, intergranular, stress corrosion, and corrosion fatigue.

Aluminum-Alloy R303. P. P. Zeigler, L. E. Householder, H. N. Hogsden, *Iron Age*, Oct. 4, 1945, pp. 74-78:—Physical properties, heat treatment, etching techniques, corrosion characteristics, and formability.

Notes on Use of Copper-Nickel Alloy in HF Alkylation Processes. B. B. Morton, *Corrosion*, Dec. 1945, pp. 228-230.

FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN, Engineer

THE PERSONNEL gradually evaporates, as it were, at the surface, so as to permit new layers to rise. The 1898 waterboy, Charlie Barber, of the Bay City sugar factory is now the superintendent of the Green Bay factory and his pal, Tom Neering, from the same job, is superintendent of the Monitor Sugar Co. Among other important ex-waterboys are the operating superintendent of the Pennsylvania Sugar Co. and the general manager of the American Crystal. The late Bob Lauber, superintendent of Wallaceburg, carried water to the thirsty constructors at Grand Island in 1889. Fred Noble, the late able plant manager of the Oxnard California factory, served as waterboy to the constructors in 1891 and every morning and night he had to walk seven miles between his home and his job.

THE GRAND ISLAND, NEB., beet sugar plant, the first of Oxnard Brothers factories, was built in 1889. The site was selected by Henry Oxnard during a visit with his friend Heywood Leavitt, Harvard classmate '82, because he could not resist the beauty of the landscape. Besides, the state legislature had promised a bounty of 1c. per lb. of sugar, provided that the company would pay the farmers $5 per ton of beets instead of the proposed $3.50. After Oxnard had obligated himself to pay $46,000 to the farmers in anticipation of reimbursement and had commenced construction of his second factory, which was located at Norfolk, Neb., the law was declared unconstitutional.

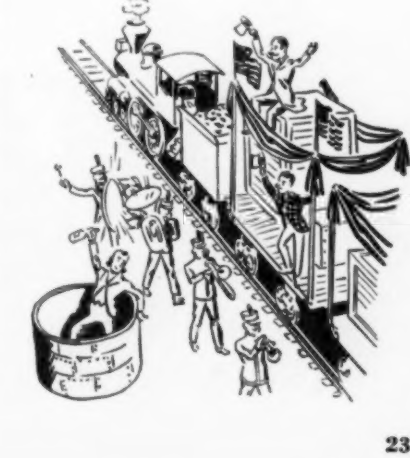
Machinery was imported from France on the basis that it was less costly to buy experience than to make it. Besides, the federal government waived the import duty on foreign sugar machinery for a three-year period. Oxnard imported a complete assortment of Frenchmen to erect and operate the works. In the process of beet sugar manufacture, the agricultural department is the division that possesses the greatest number of variables. Accordingly, Oxnard imported agronomists from Russia, Austria, Sweden, Belgium, Germany and France in order to be prepared with an expert to fit whatever agricultural conditions might be met in the untried territory. There were so many bearded Frenchmen in Grand Island that it was proposed to make French the official language of the village.

THE CARGO of machinery was transferred at the port of New Orleans onto a special through freight. When the sugar factory arrived at Lincoln enroute to Grand Island, the governor and the mayor and other important dignitaries went down to the railway yard to meet it. Also architect Fuehrman and a large delegation came up from Grand Island with a brass band to convoy the works to destination, about 100 miles. Metallic blasts were dispensed at way stations. The local editor was also in the crowd. Editorially and at home, where the mother-in-law waged abolition of the bar, the editor was dry. When he was removed from restraint he used his own judgment. Anyhow, when the train, gay with bunting and hilarity, reached Grand Island, the editor was not in condition to meet his mother-in-law and so the boys retained him in an iron tank on the railway siding till a more opportune time. This tank is now installed at the Stolley State Park and serves drinking water to the multitude.

JULES FUEHRMAN, who adapted the French architecture of the Grand Island factory to fit American-made bricks, died in New York after a successful career. The chronicler desired to secure a picture and biographical matter and therefore called on Mrs. Thuernagel, the sister of Fuehrman's wife, who lives in the Grand Island outskirts. Unfortunately, the doorbell startled her out of her afternoon's nap. She was tired, having just returned from a sojourn in Omaha. The purpose of the visit brought up a vision of uncomfortable search through the attic. The first impulse inspired distress and the chronicler's inopportune appearance made his position on the doorstep awkward. Just then Mrs. Thuernagel noticed the car at the curb and there, in the hot sun, sat the chronicler's wife. This bit of inconsiderateness brought severe criticism but before an excuse could be expressed from the doorstep, Mrs. Thuernagel was out at the curb bringing in the unexpected guest from Philadelphia!

Conversation got underway and in the following three hours much old sugar house lore and many pictures were brought out. The flower garden had of course to be inspected. It covers about a half acre surrounded by "orchids of the alley." Paths between the beds are trenches about 18 in. wide by a foot deep. These receive the weeds and plant detritus which serve as a carpet till fall. Then a new trench is dug beside the old one and the soil thrown on top of the dried weeds. This provides convenient disposal. No fire. No cartage. There is immeasurable inspiration and delight in consorting with the product of Nebraska culture as typified by kindly Old Man Thuernagel and his good wife, mellowed by more than fifty years of companionship.

SALICH'S MONUMENT at Grand Island, like grandfather's knife, is still the same old plant that he built 55 years ago, but it performs with modern efficiency. On the outside, Salich would now recognize only the old brick walls and the roof, mutilated with strange extensions. Within he would observe three of the French evaporator steam chests with their gracefully moulded bifurcated steam inlets, and he would see his company's name on the gas valve and the manhole covers on the carbonators, the shells having long been replaced. Beyond these parts he would recognize not a thing. The ten man-hours of labor required for processing a ton of beets in his time may now be reduced to about 1¼, but the cost in dollars is just the same. The pretty girls of the village who received Salich's photograph according to an old French custom still maintain angelic qualities whether living or dead. Old sugar boiler Martin Alexander and his buddies, Gus Schweiger and Gus Cornelius, now of emeritus status, still do some kibitzing at the plant. Editor Buechler, who started as a cub news hawk fresh from Cornell in 1890, is now the village grand old man. When his predecessor reached the age of 90 in 1900 he sold the paper to Buechler and associates for $7,000. Thirty years later the same old newspaper with some extensions sold for $280,000. As to Factory Manager Denman, the "Planter" announced in 1907 that he was appointed



cashier of the Grand Island factory. His predecessor, A. S. Rogers, "went to Colorado to start a bank!" In 1926 Karl Gerbemann, an attaché in a German beet sugar house, died at 89 having worked continuously in the same place for 65 years. The practice of "thereness" contains romance, poetry, morals and religion. Pure unadulterated faithfulness is always at a premium as every superintendent knows.

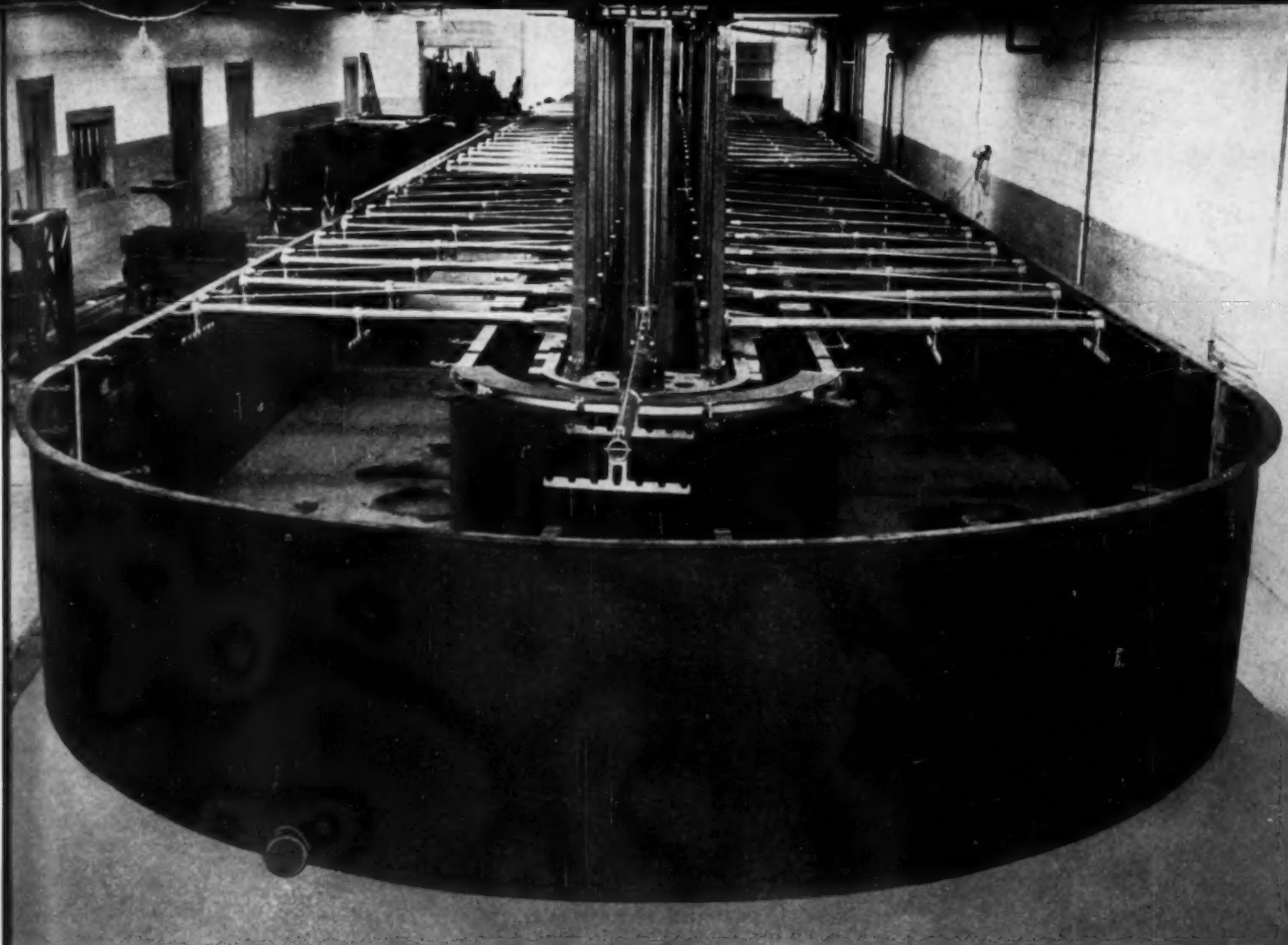
A WONDROUS PLACE is the Brach confectionery manufacturing plant in Chicago. Its annual output is 125,000,000 lb., 112,000,000 of which went to war. Eight individually wrapped Brach caramels inclosed in a cellophane jacket sell for one cent. One entrance to the plant, attractively ornamented, architecturally and horticulturally, serves every man from president to ashman and all of them pass through the same corridor decorated with rare works of art. The various workrooms are air-conditioned for comfort or technological requirements and separated by doors automatically operated by means of electric eyes. There is also music in the air which is by occasion subdued for announcements or important news flashes.

The mechanics of the works are administered by Lew Llewellyn, veteran air pilot of War I. His son piloted bombers over Europe in War II while his daughter flew the planes from factories to Army air fields. When the plant manager was approaching retirement age, Lew was appointed successor. Lew turned this down on the ground that his age would make his tenure too short to warrant the change. Accordingly he picked out one of his young engineers, strong of mind and body, and proceeded to train him to be his own boss and said boss will start at an early age that promises long uninterrupted usefulness.

BEASTS OF BURDEN have always been fed generously by appreciative masters. For practical reasons the breakfast and lunch periods have always coincided with the conventional, i.e., just before the whistle calls the craftsman from refreshment to labor. This old custom was followed by a certain crew of long shoremen who used horses to draw raw sugar, dutiable at 2c. per lb. from the ship's side to the warehouse. A large scale was provided and by approval of all concerned each horse-and-truck unit was weighed in the morning and at noon just before ship discharging began. The tare thus obtained was used for the rest of the day. After 15 years of this practice, a customs agent suddenly discovered an "irregularity" recorded in the public prints in April 1912 as follows:

"Among the ingenious methods employed was to have a team of horses weighed after they had partaken of a meal and were almost 2 lb. heavier because of the feed and water. By the process of digestion and elimination the horses would become lighter but it is said no deductions were made. While the difference in the weight of a load of sugar under these alleged circumstances was but slight, the aggregate for a year represented a large amount."

RAY WARNER, as a fresh grad from Wisconsin about '98, traveled in the South to erect cotton baling machines for professor Magnus Swenson, founder of the Swenson



MANHATTAN RUBBER LINING

on WORLD'S LARGEST RUBBER-LINED NICKEL PLATING TANK

Largest rubber-lined plating tank in the world at Daystrom Corporation, Olean, New York. Rubber-lined by Manhattan. Full automatic, elevator-type, nickel plating conveyor installed in this tank by Hanson Van Winkle Munning Company, Matawan, New Jersey.

Big in every dimension—length, breadth, and width—this huge steel tank is rubber-lined to protect it against corrosion and to eliminate contamination of the plating bath. Rubber lining also eliminates stray currents.

Like other rubber linings developed by Manhattan, this was specially compounded for its specific service—bright nickel plating. Manhattan linings are inseparably bonded to steel equipment by a special process that allows for expansion and contraction during temperature changes—without cracking.

Manhattan has been lining tanks and equipment for nearly 40 years. Its rubber lining department is one of the largest. Among a battery of vulcanizers is one of the largest in use, 15 ft. in diameter. Call in a Manhattan rubber lining engineer on your next job.

other
MANHATTAN Rubber Products for PLATERS

MANHATTAN POLISHING WHEELS: NEW in several RESILIENCIES with synthetic rubber bond. Acid Hose; Air, Water and Steam Hose; Sand Blast Hose; Filter Hose; V-Belts for plating and burnishing barrels; Conveyor and Elevator Belts; Abrasive Tumbling Barrel Material.

RAYBESTOS-MANHATTAN, INC.

RAYBESTOS R M MANHATTAN

MANHATTAN RUBBER DIVISION

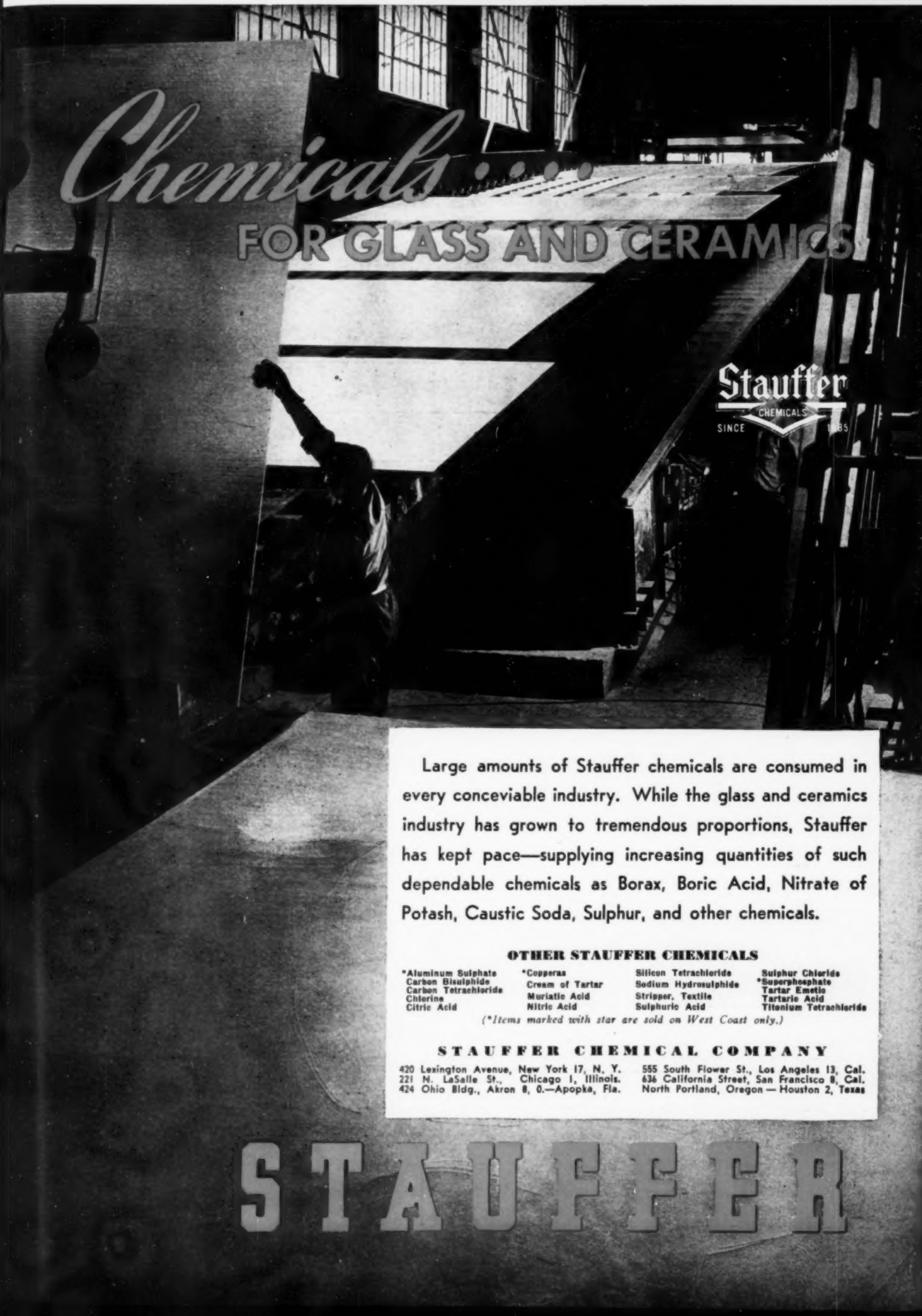
EXECUTIVE OFFICES AND FACTORIES — PASSAIC, NEW JERSEY

Evaporator Co. When the old boilers on the plantations blew off steam, the fireman grew jittery and added an extra brick to the safety valve weight. Anybody who was afraid to do this was a coward. The plantations possessed the advantageous circumstance that when a boiler blew up, there was plenty of room for dissipation of the parts.

TOMMY STOKES, now chemical director at the Savannah Refinery, held down a job in the Fort Collins laboratory about 40 years ago. He was the popular bachelor with the crude open roadster of the time and with this device he provided miles of pleasure. On an occasion he called on Harry Hooper (now district supt. at Scottsbluff, Neb.) and joined in conversation with Harry and the visiting preacher. While they were in the midst of a discussion on moral doctrines, little Helen borught in two bottles, identifying one as Uncle Tommy's medicine and the other as Daddy's.

The annual event in Harry's life is his journey to Caro, Mich., to join with Bill Mantey in the jamboree of the craftsmen there. Charlie Sieland, now 80, is the perennial master of ceremonies in the ritual of slicing the Limberger. He first grooms the cheese with a long sharp knife removing all the whiskers and mildew, and then proceeds with dexterous ceremony to partition it into generous portions. The jamboree ends in the morning with "Sweet Adaline."

THE PURPOSE OF PROGRESS is sometimes dramatically served by accident. Machinist Harold Silver of Denver developed a brainstorm into a continuous diffusion battery to replace the usual row of 14 intermittently operated tanks. This is a problem that had defied solution for 75 years. His pilot machine inspired enthusiasm but nobody was willing to take a plant size chance at $100,000 with so radical a departure. Now along came the inexperienced promoter of the new St. Hilaire factory near Montreal and in his lack of familiarity with the sugar process he was persuaded by Silver's enthusiasm to obligate his company with a contract for a machine. Later the promoter's successor as factory constructor went to Denver to request cancellation of the contract. However, the work had progressed in the shop and thus the obligation had grown to a sizeable figure. The constructor became infected with Harold's enthusiasm. Harold therefore finished the job under WPB priorities but in the fall of '43 St. Hilaire had to postpone the factory completion date for various and sundry reasons. In the meantime Harold set up his machine at his own expense at Great Western's Fort Lupton factory near Denver for a full size test with the 1943 crop. There were great misgivings. The wiseheimers predicted failure. The old battery started processing the crop, while Harold was jockeying with the new one and warming it up. He found a few bugs. By mid-campaign, the old machine was shut down and in the remaining six weeks of operation the new continuous machine chalked up a profit of $10,000. The results were so gratifying that a stampede arose for new batteries. The maching was then moved to St. Hilaire where it made history with the 1944 crop. Now that WPB restrictions have been removed, four machines are in the shop.


Chemicals....
FOR GLASS AND CERAMICS
Stauffer
CHEMICALS
SINCE
Large amounts of Stauffer chemicals are consumed in every conceivable industry. While the glass and ceramics industry has grown to tremendous proportions, Stauffer has kept pace—supplying increasing quantities of such dependable chemicals as Borax, Boric Acid, Nitrate of Potash, Caustic Soda, Sulphur, and other chemicals.
OTHER STAUFFER CHEMICALS
*Aluminum Sulphate
Carbon Bisulphide
Carbon Tetrachloride
Chlorine
Citric Acid
*Copperas
Cream of Tartar
Muriatic Acid
Nitric Acid
Silicon Tetrachloride
Sodium Hydrosulphide
Stripper, Textile
Sulphuric Acid
Sulphur Chloride
*Superphosphate
Tartar Emetic
Tartaric Acid
Titanium Tetrachloride
(*Items marked with star are sold on West Coast only.)
STAUFFER CHEMICAL COMPANY
420 Lexington Avenue, New York 17, N. Y.
221 N. LaSalle St., Chicago 1, Illinois.
424 Ohio Bldg., Akron 8, O.—Apopka, Fla.
555 South Flower St., Los Angeles 13, Cal.
636 California Street, San Francisco 8, Cal.
North Portland, Oregon — Houston 2, Texas
STAUFFER

NAMES IN THE NEWS

R. F. Warren

W. M. Scott

C. E. Loucks

Richard F. Warren has joined the staff of *Chem. & Met.* as assistant editor. Capt. Warren was recently released from active duty in the U. S. Marine Corps which he entered after receiving his B. Ch. E. from Rensselaer Polytechnic Institute in 1942.

Richard F. Messing, chemical engineer, is among five new men formerly engaged in war research projects who have joined the staff of Arthur D. Little, Inc., Cambridge, Mass. Others are: **W. H. Avery**, physical chemist; **Richard Handrick**, organic chemist; **Winslow A. Sawyer**, mechanical engineer; and **Raymond M. Hainer**, physical chemist.

Charles G. Boone, superintendent of the Pennsylvania Salt Mfg. Co. plant at Natrona, Pa., has retired after 21 years as head of Pennsalt's Natrona operations.

Edward A. O'Neal, Jr., has been promoted to the position of deputy managing director of Monsanto Chemicals, Ltd., English subsidiary of Monsanto Chemical Co. Mr. O'Neal, formerly production manager of Monsanto's phosphate division, moved to London, headquarters of the subsidiary company, earlier this month.

J. H. Cooper, formerly of the Pigments Department, Du Pont Co., has been named manager of Asphalt and Pitch Research at the Paraffine Cos., San Francisco. **L. F. Andrews**, formerly Lieutenant Commander, USNR, has been named manager of Paint Research. The company has also announced the addition to its staff of the following research chemists: **B. Borders, R. C. Brown, J. M. Butler, M. Hambrick, G. Harris, C. J. Henniker, W. M. Jaques, W. A. Kaye, R. Mattison, Jr., M. A. Orlins, G. W. Williams** and **W. L. Woodnutt.**

Daniel L. Guilfoyle, after four years in the army, has returned to his former position with Skinner & Sherman, Inc., consulting chemists of Boston.

Walter M. Scott has been named director of the U. S. Department of Agriculture's Southern Regional Research Laboratory in New Orleans. Colonel Scott, who was released from active duty in the armed forces December 30, succeeds the late **D. F. J. Lynch** who directed the laboratory from its establishment in 1938 until his death a few months ago.

Thomas G. Street, Jr., has accepted a position as research chemist in the Industrial Research Institute at the University of Chattanooga. Lieutenant Street was recently discharged from the U. S. Army Air Forces.

Perry L. Bidstrup has accepted an appointment to the technical staff of the Midwest Research Institute where he will work in the institute's Agricultural Chemistry Department. Lieutenant Bidstrup was recently discharged from the 5th Marine Division, USMC.

R. S. Jane, for the past three years director of industrial research department of the Shawinigan Water & Power Co., has been appointed vice president in charge of research of Shawinigan Chemicals Ltd., succeeding **Howard W. Matheson**, who retired because of ill health.

James R. Downing has been appointed director of research at Cook Electric Co., Chicago. Since 1942, Dr. Downing's major work has been with the Manhattan Engineer District and in the development of high vacuum equipment for industry.

R. W. Perlich has been appointed chief chemist of the analytical branch of the Central Research Laboratory of the Minnesota Mining & Mfg. Co.

Raymond B. Stringfield has been appointed general manager and technical director of Reeves Rubber Co., San Clemente, Calif.

Charles E. Loucks has been appointed director of research and development for the Chemical Warfare Service. Brigadier General Loucks recently returned from Tokyo where he was chief chemical officer to General MacArthur. In an earlier assignment as Chief Chemical Warfare Field Representative in Manila, General Loucks was responsible for supplying the army in the Pacific with chemical warfare materiel.

Milton Harris has been appointed visiting professor of textile chemistry at the Polytechnic Institute of Brooklyn where he will be associated with the Highpolymer Research Institute.

J. Elton Lodewick, formerly chief of the division of forest products for the Pacific Northwest Forest and Range Experiment station in Portland, has been appointed forest products analyst for the Bonneville Power Administration, Portland, Ore.

Claude E. Needham, editor of the U. S. Bureau of Mines Minerals Yearbook has been appointed supervisor of the division's office at Salt Lake City. Work of the three other offices at Denver, San Francisco and Joplin, Mo., will be coordinated there. **George E. Woodward** was named supervising engineer of the Denver office and **Alfred L. Ransome** supervisor at San Francisco.

William Volk, formerly of the Institute of Gas Technology, has joined the staff of the Emulsol Corp. of Chicago and assumed duties of chemical engineer in Emulsol's production department.

Herbert F. Weaver has been appointed production manager of Monsanto Chemical Co.'s Phosphate Division, succeeding **Edward A. O'Neal, Jr. J. F. Reeves**, formerly assistant plant manager, will succeed Weaver as manager of Monsanto's plant at Anniston, Ala.; **A. T. Beauregard**, manager of the

company's elemental phosphorus plant at Monsanto, Tenn., has been transferred to St. Louis as special assistant to Cole; and **John L. Christian,** formerly assistant plant manager at the Tennesee operations, will succeed Beauregard.

C. B. Callomon, formerly chief metallurgist at Western Gear Works, Lynwood, Calif., has severed his connections with that company. He has taken over the Metal Control Laboratories of Los Angeles, Calif., in the capacity of general manager and chief metallurgist.

J. C. Neemes, Jr., metallurgist, is director of the recently established Twin Cities Technical Section of the Development and Research Division of the International Nickel Co.

Arthur D. Beers, formerly assistant superintendent of the central mills of Carnegie-Illinois Steel Corp. at Gary, Ind., has been named superintendent. Mr. Beers has been associated with the plant since April 1911 when he started as a chemist.

Locke White, Jr., has left the Naval Research Laboratory, Washington, D. C., to join the staff of Southern Research Institute, Birmingham, Ala.

LaVerne E. Cheyney, formerly section manager in the chemical products development division of the Goodyear Tire & Rubber Co., Akron, has joined the staff of Battelle Memorial Institute, Columbus, where he will be associated with its division of organic chemistry and will specialize in rubber technology.

Harry S. Amer has retred after a 37-year career as an incandescent lamp development engineer with the Westinghouse Lamp Division at Bloomfield, N. J.

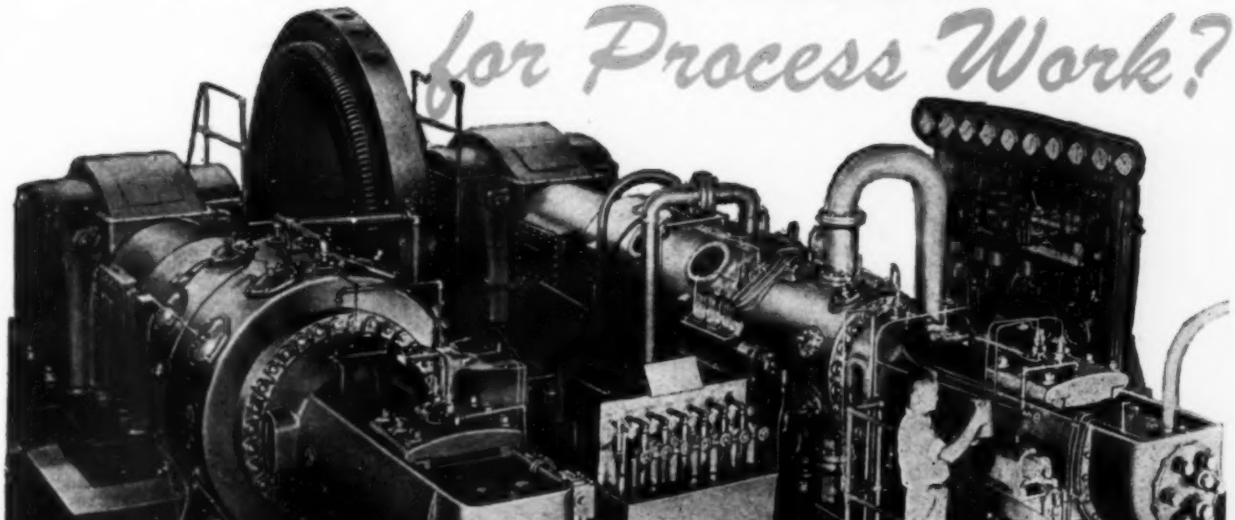
Joseph Early has been named staff assistant to the superintendent of the glass plant of the Westinghouse Lamp Division plant at Fairmont, W. Va.

Richard W. Hyde and **Robert I. Brown,** chemical engineers, have rejoined the staff of Arthur D. Little in Cambridge, Mass. Also rejoining after service with the armed forces are: **Harry B. Wissmann,** economist; **J. T. Howarth,** resin chemist; **Ekkehard L. Kreidl,** physical chemist and patent specialist. Other veterans joining the staff are: **H. M. Anderson, E. C. Crocker, D. E. Boynton,** chemical engineers; **R. M. Adams,** draftsman **John L. Sienczyk,** chemist; and **G. P. Douglas,** maintenance.

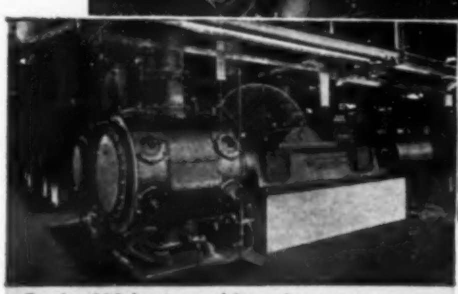
Fred F. Diwoky has been appointed head of the newly created research and development department of Cuneo Press, Inc., Chicago. Dr. Diwoky was recently released from the army as a major and was stationed at the CWS Development Laboratory at MIT, Cambridge. He was formerly affiliated with the Standard Oil Co. (Ind.).

C. A. Woodbury, manager of the Technical Division, Explosives Department, E. I. du Pont de Nemours & Co., and **I. J. Cox,** manager of the American Glycerin Section

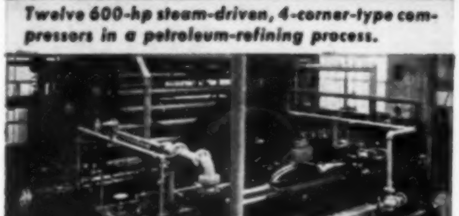
What assures a GOOD COMPRESSOR *for Process Work?*



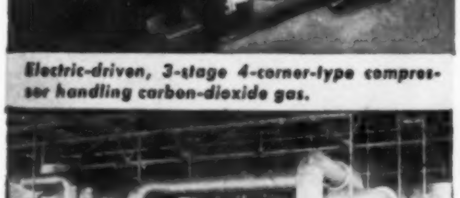
One of six 2500-hp Ingersoll-Rand 7-stage units compressing nitrogen and hydrogen to 15,000 psi for making synthetic ammonia.



Twelve 600-hp steam-driven, 4-corner-type compressors in a petroleum-refining process.



Electric-driven, 3-stage 4-corner-type compressor handling carbon-dioxide gas.



← Three electric-driven, 2-stage 4-corner-type, ammonia compressors used in a petroleum-refining process.

Here is what assures a good compressor for those processes where interruptions of the cycle may cause large losses in production, introduce conditions that may be dangerous or hazardous, or necessitate extensive repairs or replacements:

> **The compressor manufacturer must have sufficient knowledge to enable him to predict in advance what conditions in the process might cause a shut-down of the compressor . . . and then must be able to design and build the compressor so that any possibility of interruption of service is reduced to a minimum.**

The only way to obtain such knowledge is through years of actual engineering experience in building and applying compressors for all kinds of processes . . . for handling all sorts of gases . . . and for any range of pressures.

Ingersoll-Rand has that kind of experience, and can help you with your compressor problems.

AIR TOOLS
COMPRESSORS
ROCK DRILLS
TURBO BLOWERS
CONDENSERS
CENTRIFUGAL PUMPS
OIL & GAS ENGINES

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

1-767

and production manager of the Black Powder Section, have retired. **B. H. Mackey** will succeed Mr. Woodbury while the duties of Mr. Cox in the glycerin section will be taken over by **G. H. Loving** and those in the powder section by **H. K. Babbitt.**

Bachrach

W. A. LaLande, Jr.

W. A. LaLande, Jr., has been appointed director of Whitemarsh Research Laboratories of the Pennsylvania Salt Manufacturing Co. Dr. LaLande was formerly director of research of the Attapulgus Clay Co. and previously a member of the chemistry faculty of the University of Pennsylvania. He came to Pennsalt in August 1944 as director of the Research Division.

Darrell Althausen has joined the firm of Fritzsche Brothers, Inc., essential oil and aromatic chemical house, where he heads the company's New Products Department.

H. R. Duffey, formerly chief engineer of the Vulcan Copper & Supply Co., has joined the research group of the Quaker Oats Co.

Jack Wolk has joined the research and development department of the Emulsol Corp. of Chicago. Mr. Wolk comes to Emulsol from Washington where he was with the Food and Drug Administration.

John V. N. Dorr returned to this country last month after an eight-week visit to Europe in connection with The Dorr Co.'s business in Great Britain and on the Continent.

William G. Cooper and **William F. Winemiller,** both Ohio State University graduates, have joined the staff of the Ohio State University's Engineering Experiment Station.

Paul F. Corbin of the Textileather Corp., has been elected president of the Toledo Section, Society of Plastics Engineers.

John W. Wright, formerly director of research at the Fyr Fyter Co., has joined the research staff on Monsanto Chemical Co. in Dayton.

Sherman E. Smith, formerly of the faculty of the University of North Carolina, has become the head of the Department of

5 reasons

1. Gears are continuous tooth herringbone—the famous *Gear with a Backbone. Backbone,* the place where the helices meet, provides extra strength and load-carrying capacity. Accurate tooth contour, gradual engagement and oblique lines of contact assure correct tooth action, minimizing wear.
2. Precision ground shafts are designed to provide the rigidity necessary to prevent deflection and keep gears in exact alignment.
3. Roller bearings of adequate size for the job hold the shafts in precise alignment.
4. Heavy section housing holds rotating elements in original accurate alignment. Exterior ribbing at bearing points gives extra protection against deflection.
5. A continuous splash lubrication system provides ample oil supply to gears and bearings. A trough system of oil feed to the bearings provides a surplus flow with fixed regulation for ample supply. End covers and baffles at shafts prevent possibility of oil leakage, or entrance of dust and dirt.

WHY EFFICIENCY STAYS "YOUNG" IN THIS SPEED REDUCER

The power transmission efficiency of a new Farrel speed reducer is 98% to 98.8%. To preserve this original efficiency...to keep it "young" during long, exacting service, Farrel has designed in protection at 5 vital places.

This 5-point protection minimizes wear and assures the continuance of original power transmitting performance for many years of trouble-free operation.

Farrel Speed Reducers are available in a complete range of sizes for any application. Ratios of single reduction units range from 1½:1 to 10:1, double reduction units up to 60:1, and triple reduction units up to 180:1. For complete information write for catalog No. 438.

FARREL

FB-279

FARREL-BIRMINGHAM COMPANY, Inc.
344 VULCAN STREET • BUFFALO, N. Y.
Plants: Ansonia, Derby and Stonington, Conn., Buffalo, New York
Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Los Angeles, Tulsa, Houston, Charlotte

Farrel-Birmingham

Chemistry, University of New Mexico, Albuquerque.

Hunter Nicholson, a chemistry graduate of California Institute of Technology, has been made factory manager of Kelite Products, Inc., Los Angeles.

Gwilym A. Price has been elected president of Westinghouse Electric Corp. succeeding **George H. Bucher** who has resigned.

R. C. Gibson has returned to his former position as director of research at the Parker Rust-Proof Co., Detroit. **E. W. Goodspeed,** former assistant research director is now assisting in the office of the president, and **H. J. Lodeesen** has been promoted to the position of assistant research director. Four new additions to the research staff are: **George A. Baumstark, R. I. Somers, A. R. Anderson and C. G. Neuroth.**

R. David Thomas, Jr., director of research and engineering of Arcos Corp. has been elected vice president.

Allen B. Williams has been made president of the Aluminum Ore Co. succeeding **Charles B. Fox** who retired recently.

Julian M. Avery has resigned as vice president in charge of research and development of the Diamond Alkali Co. to establish a private consulting practice.

C. W. Bendigo has been named editor of *Textile World*, a McGraw-Hill publication.

Charles Davidoff, formerly vice president in charge of chemical engineering at Sam Tour & Co., has announced opening of offices and laboratories in New York where he will specialize in chemical and metallurgical investigations.

J. Davidson Pratt recently returned to his duties with the Association of British Chemical Manufacturers.

Morris B. Jacobs, senior chemist, Department of Health of the City of New York, has been designated chief of the chemical laboratory of the department.

Hiland G. Batcheller, president of Allegheny Ludlum Steel Corp., has been elected to the board of trustees of Industrial Hygiene Foundation.

Rufus K. Allison, formerly with the B. F Goodrich Co., has joined the staff of Southern Research Institute, Birmingham, Ala.

J. Fraser Rae has joined Western Fiberglas Supply, Ltd., of San Francisco, as chief of its plastics division. Formerly plastics instructor and consultant for the University of California, Rae has also been special consultant on plastics for various technical schools and for the U. S. Navy. He is a graduate of Aberdeen University.

A. F. Swain, recently returned from the research and development branch of the Office of the Quartermaster General, has been made manager of the insecticide and

Furfural's ABILITY TO DISCRIMINATE MAKES IT VALUABLE TO YOU

FURFURAL might very well be called the chemical with the high I.Q. That's because it seems to use an inherent intelligence in picking its solutes. These unique selective solvent properties have contributed to economical and efficient production in many fields.

The use of Furfural as a selective solvent is outstanding in:

1. Lubricating Oil Refining
2. Synthetic Rubber
3. Glyceride Oils
4. Wood Rosin

OTHER USES FOR VERSATILE *Furfural*...

Pre-eminent as is the use of Furfural because of its selective solvent properties, this versatile aldehyde is gaining new adherents because of its other properties, too.

Other uses of Furfural growing in importance continuously, are as a dispersant in resinoid-bonded abrasive wheels, dyes, lacquers, varnish removers, etc.; as a resin former and plasticizer in the manufacture of phenolic and non-phenolic resins; as a fungicide and bactericide, and as a highly reactive intermediate for the production of many organic compounds.

Furfural PLENTIFUL AND ECONOMICAL...

Furfural is the cheapest pure aldehyde available today. It sells for 9½ cents per pound in tank car lots FOB Cedar Rapids, Iowa. The supply of Furfural is ample to meet all present and anticipated needs and a program to keep production facilities ahead of increasing demands is already in operation.

Furfural's PERFORMANCE WARRANTS YOUR INTEREST...

Furfural's performance on so many fronts justifies your investigation of its possibilities for your particular needs. You are invited to call on our Technical Staff to help you in evaluating this chemical for your proposed applications. A little time spent in Furfural exploration now may repay you in shortening time and lessening costs in the manufacture of your product. A sample of Furfural will be sent you when requested on your letterhead.

A New BULLETIN *on* *Furfural*

We have in preparation a series of bulletins on Furfural and the other Furans. The first bulletin in this series, No. 201, is available now. It contains general information on Furfural and is both interesting and up to date. Send for your copy now.

PROPERTIES OF QUAKER FURFURAL

(Furfuraldehyde, C_4H_3O-CHO)

Amber-colored liquid of high stability and unusual purity

Molecular Weight............96.08
Freezing Point, °C............ −37
Boiling Range (99%)°C..157 to 167
Specific Gravity (20/20°C)....1.161
Flash Point (open cup)°C..........56
Refractive Index (20/D)......1.5261
Surface Tension at 20° C (dynes/cm) 49
Viscosity at 38°C (centipoises)..1.35

Solubility: Completely miscible with ethyl alcohol, ether, acetone, benzol, butyl acetate, china wood oil and most organic solvents except petroleum hydrocarbons and glycerol; 8.13% by wt. in water at 20°C.

Analysis:
Furfural, minimum %..........*99.5
Water, maximum %............0.2
Organic Acidity, Maximum equiv/1..................0.023
Ash, maximum %............0.006
Mineral Acidity..............None
Sulfates....................None
Ketones.....................None

*As determined by A.O.A.C. method.

Standard Containers: 9, 45, 90, and 520 lb. Drums
†Carload of Drums 80 to 88..41,600 to 45,760 lbs.
Tank car 8,000 gal.................78,000 lbs.
Tank car 10,000 gal................98,000 lbs.

†ODT requires maximum loading

Drums non-returnable

The Quaker Oats Company CHEMICALS DEPT.

1940 BOARD OF TRADE BLDG.
141 W. JACKSON BLVD., CHICAGO 4, ILLINOIS

FURFURAL • FURFURYL ALCOHOL • FUROIC ACID • TETRAHYDROFURFURYL ALCOHOL

fumigation department of the Pittsberg Chemical Co., Los Angeles.

Howard D. Tyner, physicist and chemist, has been named director of the newly formed Rocky Mountain Institute for Industrial Research, Colorado Springs, Colo.

Elizabeth Roboz, formerly at the California Institute of Technology, is now research chemist with the rank of associate professor at the Natural Resources Research Institute of the University of Wyoming at Laramie.

Raymond W. Parker has been appointed chief engineer of Standard of California's manufacturing department. A graduate of the University of British Columbia, Parker was formerly with the company's El Segundo and Richmond, Calif., refineries.

H. P. Weber, after serving as captain in the Ordnance Dept. of the U. S. Army for two years, has returned to his former position as research engineer for the California Research Corp., Richmond, Calif.

Paul Sanders, formerly refinery foreman for General Petroleum Corp. of Calif., Torrance, Calif., has been advanced to refinery superintendent. **W. M. Manley** has been promoted to assistant refinery superintendent.

Ralph H. Hopp, a chemical engineering graduate of the University of Nebraska, has been appointed librarian at Battelle Memorial Institute, Columbus.

Jacquard H. Rothchild, a colonel with Chemical Warfare Service, has been appointed chief of the CWS technical division.

Gustav Egloff, of Universal Oil Products Co. and president of the American Institute of Chemists, has left for China to head a mission for the Chinese government on the rehabilitation and development of the petroleum industries there.

Horace T. Herrick has left the directorship of the Northern Regional Research Laboratory at Peoria, Ill., to become special assistant to the chief of the Bureau of Agricultural and Industrial Chemistry of the U. S. Department of Agriculture. He has been succeeded at Peoria by **G. E. Hilbert.**

John M. Brentlinger, manager of the Industrial Engineering Division, and **George E. Burd,** assistant manager of the Employee Relations Division, Organic Chemicals Department, E. I. du Pont de Nemours & Co., have retired.

J. W. Kitts, production manager of the Military Explosives Division, E. I. du Pont de Nemours & Co., has been named to succeed **P. C. Kaiser** as manager of the Repauno Works of the Du Pont Co. Mr. Kitts, a chemical engineering graduate from the University of Pennsylvania, has been with Du Pont since 1916. Mr. Kaiser, who has been with the company since 1911, is retiring for reasons of health.

Joseph A. Neubauer has been appointed to the position of technical adviser to the

CALL ON CROLOY for the RIGHT ANALYSES in Tubing for *ANY KIND of SERVICE*

CROLOY 1¼	CROLOY 2¼	CROLOY 3 M
Economic grade good creep strength properties. Somewhat more corrosion resistant than the chromium free steels.	*Exceptionally high creep strength* for polymerization and high pressure cracking. Otherwise similar in properties and characteristics to Croloy 2.	Somewhat better creep properties and better resistance to corrosion and oxidation than Croloy 2.
CROLOY 5	**CROLOY 7**	**CROLOY 9**
For operating conditions where corrosion resistance is primary requirement—provides good creep strength and oxidation resistance superior to Croloy 2.	Intermediate steel between Croloys 5 and 9 for operating conditions where corrosion resistance is the primary requirement. Somewhat more oxidation resistant than Croloy 5.	For severe operating conditions where high corrosion and oxidation resistance are essential—suitable for hydrogenation processes.
CROLOY 18-8S	**CROLOY 18-8SCB**	**CROLOY 25-20**
Practically unaffected by extremely corrosive oils at high temperatures. Has high creep strength and high resistance to oxidation.	Similar in properties to CROLOY 18-8S but stabilized with columbium, making it adaptable for welding or heating in carbide range.	For extreme resistance to oxidation and corrosion, for high-pressure, high-temperature services, as in hydrogenation, polymerization, and special heat-resisting installations.

In matching tubes to today's refining and processing operations, B&W Croloys provide you with a complete range of steel analyses from which you can be sure of getting the correct tubing for any specific requirement.

Because performance of Croloy tubing can be predicted in the laboratory with unvarying accuracy, you can depend on it to give long life, dependable service at low ultimate cost on the job.

B&W low and intermediate Croloys have been developed expressly for applications requiring resistance to high temperatures, high pressures, corrosive attack, creep strength and all other adverse conditions. They are in wide use today in refineries, synthetic rubber plants and chemical industries, giving highly satisfactory and economical results.

Among B&W Croloys there is ample selection to assure the best alloy for any given condition. Data on creep strength, tensile strength and other physical characteristics are available to help you determine the tubing best suited for each job. So is the cooperation of B&W engineers. When you call on Croloy, you call on their advice and assistance backed by long experience in successfully solving tough tubing problems.

TA1324

B&W

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

BABCOCK & WILCOX SEAMLESS & WELDED TUBES

THE BABCOCK & WILCOX TUBE COMPANY
WELDED TUBE DIVISION ALLIANCE OHIO • SEAMLESS TUBE DIVISION BEAVER FALLS, PA.

Columbia Chemical Division of the Pittsburgh Plate Glass Co. He will be located in the general office at Pittsburgh.

Richard J. Lund, mineral economist and geologist, has joined the staff of Battelle Memorial Institute, Columbus. Dr. Lund will work on the institute's expanding studies of technical-economic problems.

Russell M. Jones, formerly assistant manager, Chemical Sales, in the Sales Agency Department of the Barrett Division, Allied Chemical & Dye Corp., has been appointed manager of new product development.

Stewart G. Fletcher has been engaged by Latrobe Electric Steel Co. as chief research metallurgist. Dr. Fletcher will direct an expanded research program. His headquarters will be at the Latrobe, Pa., plant.

Edward Larson has resigned after serving for more than five years as executive secretary of the National Society of Professional Engineers.

James C. Barnaby, consulting engineer of Worthington Pump & Machinery Corp., has been transferred to the general engineering staff at the Harrison Works as assistant director of research and development.

Norwood C. Thornton, formerly with the Boyce Thompson Institute for Plant Research, has joined the Fine Chemicals Division of Carbide & Carbon Chemicals Corp. where he will assist in the study of the use of synthetic organic chemicals in various biological fields and similar applications.

W. T. Ayer of the Engineering Department of the Hercules Powder Co., has retired after 27 years of service with the company.

Henry R. Kreider has been named chief chemist of the Wm. S. Merrell Co., pharmaceutical manufacturing concern.

Bernhart Troxler, smokeless powder production adviser, has retired after 32 years with the Hercules Powder Co.

Francis Godwin, Latin American research expert and formerly associate director of the Armour Research Foundation, has been named director of the Inter-American Research Service.

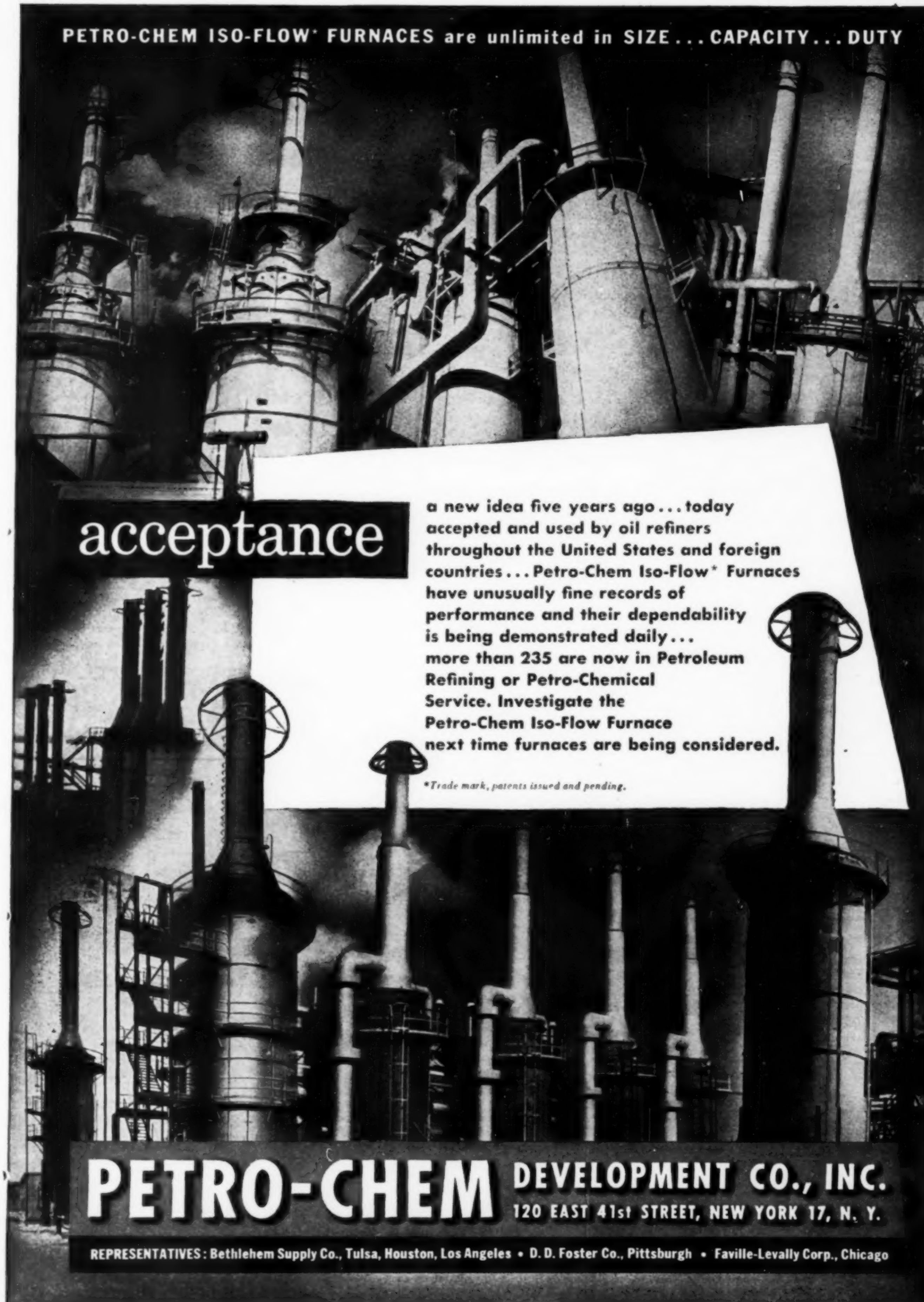
OBITUARIES

Freeman D. Lohr, 53, works manager of the Seaboard Division of the Koppers Co., Inc., in Kearny, N. J., and an authority on the operation of byproduct coke plants, died in New York January 16.

Dean J. Hill, 63, manager of the Pacific Coast branch of Kinney Manufacturing Co., died in Los Angeles, January 18.

Hugh M. Campbell, 59, a chemist associated with Cincinnati Chemical Works, died January 24.

Oscar H. Wurster, 64, president of Wurster & Sanger, Inc., chemical engineers, died in Chicago, January 25.


PETRO-CHEM ISO-FLOW* FURNACES are unlimited in SIZE... CAPACITY... DUTY
acceptance
a new idea five years ago... today accepted and used by oil refiners throughout the United States and foreign countries... Petro-Chem Iso-Flow* Furnaces have unusually fine records of performance and their dependability is being demonstrated daily... more than 235 are now in Petroleum Refining or Petro-Chemical Service. Investigate the Petro-Chem Iso-Flow Furnace next time furnaces are being considered.
*Trade mark, patents issued and pending.
PETRO-CHEM DEVELOPMENT CO., INC.
120 EAST 41st STREET, NEW YORK 17, N. Y.
REPRESENTATIVES: Bethlehem Supply Co., Tulsa, Houston, Los Angeles • D. D. Foster Co., Pittsburgh • Faville-Levally Corp., Chicago

INDUSTRIAL NOTES

National Oil Products Co., Richmond, Calif., has announced that "Les" Brown has been promoted to Pacific coast sales manager to handle this firm's vitamin materials. His headquarters will be at Richmond, Calif.

Arrowhead Rubber Co., Los Angeles, a division of National Motor Bearing, Inc., has announced the appointment of Earl F. Noyes to the post of sales manager. Noyes also will be in charge of developing new markets for the firm's fiber-glass-rubber products.

Pittsberg Chemical Co., Los Angeles, has announced the appointment of Ted C. Coleman as distributor in Brazil for insecticides, fumigants and potassium metabisulphite. Mr. Coleman, who was formerly vice president of Northrope Aircraft, will have his headquarters in Sao Paulo.

Union Oil Co., Los Angeles, through its chemical division, has taken over the sales, handling and distribution of all chemical byproducts of the Kaiser Fontana operations. This wil include cresote oil, ammonium sulphate, benzol, toluol, xylol, solvent naphtha and sodium phenolate.

Stauffer Chemical Co., New York, through its subsidiary American Cream of Tartar Co., has purchased the Tartar Chemical Works of Brooklyn, a subsidiary of Standard Brands.

The Dicalite Co., Los Angeles, has opened a new branch office in the Maccabees Bldg., Detroit. I. J. Snider has been named manager of the new office. Gordon G. Halvorsen has been appointed manager of the Cleveland Office to succeed H. L. Dunham.

Central Iron & Steel Co., Harrisburg, Pa., has appointed Irving M. Smith, general manager of sales.

The Bristol Co., Waterbury, Conn., has added George S. Witham to its staff. He will be connected with the pulp and paper instruments division.

Ansul Chemical Co., Marinette, Wis., has advanced Clarence L. Johnson to the position of manager of the Dugas office in Chicago. He succeeds Floyd M. Duvall who has been transferred to Indianapolis to take charge of refrigeration sales.

The Durabla Mfg. Co., New York, has moved its production activities from its former location in Berwyn, Pa., to a newly reconstructed plant at Wayne, Pa.

Star Electric Motor Co., Bloomfield, N. J., has added James Adair to its sales engineering staff. Mr. Adair will work in the New Jersey industrial area.

Koppers Co., Pittsburgh, has appointed Dr. Walter C. Rueckel district sales manager of

the engineering and construction division. He will make his headquarters in the branch office at 60 E. 42nd St., New York. Elliott Preston succeeds him as general superintendent of operations.

Bridgeport Brass Co., Bridgeport, Conn., has promoted C. L. Hancock to the position of manager of the technical service department, with headquarters in Bridgeport. He had been connected with sales work of the New York office.

Frank J. Edwards Co., New York, has been formed by Frank J. Edwards, formerly with Phillip Bros. The new company will maintain offices at 15 Williams St., New York, under the personal direction of Mr. Edwards.

The Edward Valve & Mfg. Co., East Chicago, Ind., has been renamed Edward Valves, Inc. The company, which manufactures cast and forged steel valves, is a subsidiary of the Rockwell Mfg. Co.

The Ajax Electric Co., Philadelphia, has formed a subsidiary known as the Ajax International Co. Officers of the new company include G. H. Clamer, chairman of the board, and Wm. Adam, Jr., president.

William R. Warner & Co., Inc., New York, has announced the retirement of its chief executive G. A. Pfeiffer. Elmer H. Bobst, former president of Hoffman-LaRoche, Inc., is the new president, and he will take over general direction of the company, together with its domestic and foreign subsidiaries.

Laclede-Christy Clay Products Co., St. Louis, has purchased the properties and business of the Alabama Clay Products Co. of Birmingham, Ala. These properties will continue to be operated by the Alabama company as a wholly-owned subsidiary of Laclede-Christy.

General Blower Co., Morton Grove, Ill., has closed its Chicago plant and consolidated its general offices and manufacturing facilities at Morton Grove. A sales office is being maintained at 510 North Dearborn St., Chicago. A branch office has been opened in the Bessemer Bldg., Pittsburgh, with John J. Homan as manager.

The American Oil and Disinfectant Corp., New York, has announced that Lt. Kurt L. Sonneborn, formerly with the Army Air Forces, has been appointed to the sales staff in Chicago. George D. Fowlkes, also joined the company's sales office at Charlotte, N. C.

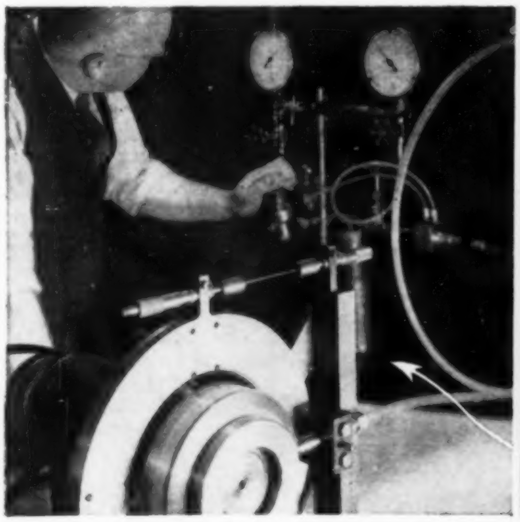
International Plastic Corp., Morristown, N. J., has disclosed that A. Edwin Philips, formerly with the White Rock Corp., has been named vice-president in charge of marketing for their company.

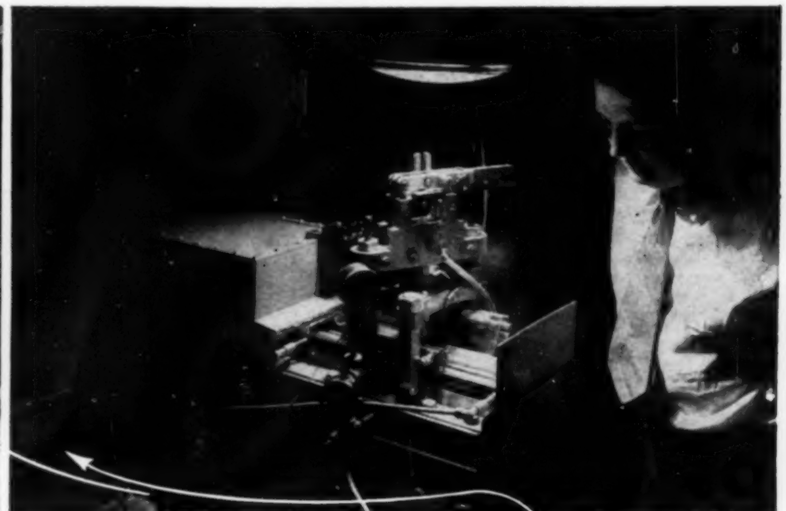
American Hard Rubber Co., New York, has acquired the Saran division of the Hodgman Rubber Co. of Framingham, Mass. The new Saran division will be headed by S. J. Smith.

The Timken Roller Bearing Co., Canton, Ohio has promoted Fred Reiser, Jr., from district manager at Cincinnati, to division manager for all divisions of the company in

Even the most perfectly turned shaft may deflect when operated under a load at high speed; as a result, the film of oil between shaft and bearing may vary in thickness. This device measures such variation by means of streams of compressed air blowing out of a metal tip against the revolving drum mounted on the shaft. The gages measure a shaft deflection of as little as one millionth of an inch.

Cylinder walls, piston rings, ana engine oils are given the third degree in this Gulf-designed scuff tester. A section of a cylinder wall on the bed of the machine travels back and forth at high speed under a small piece of piston ring while a test oil is fed a drop at a time. The light above is a stroboscope which flashes on during each forward stroke of the machine so that the cylinder wall segment appears to be motionless even though it is traveling at high speed.





with the aid of equipment like this

GULF TECHNOLOGISTS

develop better petroleum products like these

GULF TECHNOLOGISTS have devised many types of special apparatus and equipment that predetermine the performance values of lubricants. Thus, new lubrication data is continually developed to supplement the vast knowledge gained through contact with thousands of plant operating problems each year.

This continuous research effort has led to the development of oils and greases with better performance values, such as those listed at the right. Some of these Gulf quality products probably have specific applications in your plant, where they will contribute to improved production—both in quantity and quality—and dollar savings in maintenance costs.

If you have a lubrication, cutting, or quenching problem, let Gulf co-operate with you in developing the best solution. Write, wire, or phone your nearest Gulf office today and ask a Gulf Service Engineer to call.

Gulfcrest, the world's finest turbine oil
Gulf Dieselube H.D., the modern oil for heavy-duty service in gasoline & Diesel engines
Gulfgem Oil—Alchlor Processed—for spindle lubrication
Gulf Lasupar Cutting Oil, for specific metal cutting operations
Gulf Cut-Aid, for cutting non-ferrous metals
Gulf Anti-friction Grease, for ball and roller bearing lubrication
Gulf Parvis Oil, for industrial and marine Diesels
Gulf Plastic Petroleum, for lubrication under extreme temperature variations

Gulf Oil Corporation · Gulf Refining Company

DIVISION SALES OFFICES:

Boston • New York • Philadelphia • Pittsburgh • Atlanta
New Orleans • Houston • Louisville • Toledo

GULF INDUSTRIAL LUBRICATION

that city including industrial, steel, automotive, and service-sales.

The Dexter Chemical Corp., New York, has appointed Azel W. Mack vice president of its textile chemical division. Mr. Mack will be in charge of the Boston sales office.

The Ohio Stainless Steel Co., Cleveland, reports that Allen Hurt has been appointed sales manager of that company. Mr. Hurt was formerly associated with the Federal Telephone and Radio Corp., Newark, N. J.

The Colorado Fuel & Iron Corp., New York, will be represented on the West Coast by the California Wire Cloth Corp., in matters concerning sales and service operations.

John A. Chew, Inc., New York, now includes in its organization Capt. Robert P. Chew, son of the founder of the company. Captain Chew recently was released from the armed services which he joined in 1942 upon his graduation from Princeton University.

National Magnesium Corp., of Maryland, with general offices at 74 Trinity Place, New York, has elected John J. Conroy, III, president and Milton Lennard, vice president. George W. Lonergan has been elected treasurer. He also is president of the H. V. Walker Co., Elizabeth, N. J.

United States Rubber Export Co., Ltd., New York, has elected L. C. Boos, president, and Herbert G. Kieswetter, vice president. Mr. Boos, formerly vice president, will continue as general manager, and Mr. Kieswetter will continue as assistant general manager.

Westvaco Chlorine Products Corp., New York, announces that Theodore Riedeburg has joined the company as technical service representative in charge of insecticides and fumigants.

Bryant Heater Co., Cleveland, Ohio recently formed a new industrial division with Donald A. Campbell as manager. The company has added Robert M. Buck and Robert A. Clark to the development staff of the division.

Parry Engineering Co., New York, is again under the direction of its founder, Capt. Henry L. Parry, returned after a five-year service in the U. S. Navy. Clifford J. Heath and Donald Spangler have been added to the sales staff. The company is the New York representative of the Prat-Daniel Corp. and the Thermix Engineering Co.

Pennsylvania Salt Mfg. Co., Philadelphia, has named J. G. Brunton, eastern sales manager, and J. S. Francis western sales manager of the agricultural chemical division. Both had been serving as assistant sales managers in their respective territories.

Victor Chemical Works, Chicago, recently announced it would build a new electric elemental phosphorous plant in Florida. The exact location of the plant is now given as on tidewater near Tarpon Springs, northwest of Tampa. Construction will start as

soon as contracts can be let and materials and equipment assembled.

Mathieson Alkali Works, New York, has named John O. Logan an assistant general manager of sales. J. B. Peake continues as an assistant general manager of sales but is succeeded as New York district sales manager by Harry P. Smith.

Joseph T. Ryerson & Son, Inc., Chicago, has moved James M. Mead from Chicago to Jersey City where he will manage the Ryerson New York steel-service plant. He succeeds Harry W. Treleaven who has resigned.

American Car and Foundry Co., New York, recently elected P. A. Hollar vice president and now announces that he will direct sales activities in the western territory including Chicago, St. Louis, St. Paul and San Francisco. J. H. Van Moss will continue in charge of the Chicago district where Mr. Holar will make his headquarters.

Lithaloys Corp., New York, announces that Col. M. E. Erdofy has joined its executive staff. Before the war Colonel Erdofy was a consulting metallurgical and industrial engineer.

American Cynamid Co., New York, has made Floyd T. Ridley traffic manager of the Calco Chemical Division, Bound Brook, N. J.

Ceco Steel Products Corp., Chicago, is building two additions to its manufacturing division plant. This is the start of an expansion program which will involve 14 plants from coast to coast.

Dearborn Chemical Co., Chicago, has appointed Arnold J. Reardon to its sales engineering staff. His work will center mainly in the aircraft industry and with air line companies.

The Ajax Electric Co., Philadelphia, has appointed John P. Clark as sales engineer. He will make his headquarters in the main office, but his territory will cover several of the adjacent states.

Gunk Chicago, Chicago, is the name of a new chemical plant licensed by the Curran Corp., Malden, Mass. to process and sell its products in the Chicago territory. The new plant is located on the Belt Railroad near the municipal airport. Charles J. Dempsey is manager, John Stanley, chief engineer, and Donald Dempsey, sales manager.

The Pittsburgh Plate Glass Co., Pittsburgh, has begun construction on a new plant at Springdale near Pittsburgh. The plant, which will cost $1,750,000, is expected to be in operation next August. It will be the eighth plant of the company for the manufacture of paints.

Rockwell Mfg. Co., Pittsburgh, has approved changes in the names of subsidiaries. Pittsburgh Equitable Meter Co. becomes the Rockwell Mfg. Co. with the Equitable Meter name kept as a subsidiary. Name of the H. A. Smith Machine Co., Hopewell, N. J. has been changed to Rockwell Machine Co. The Merco Nordstrom Valve Co. is now called the Nordstrom Valve Co.

Producers of

SULPHUR

Large stocks carried at all times, permitting prompt shipments . . . Uniformly high purity of 99½% or better . . . Free of arsenic, selenium and tellurium.

★

TEXAS GULF SULPHUR CO. INC.
75 E. 45th Street New York 17, N.Y.
Mine: Newgulf, Texas

CONVENTION PAPER ABSTRACTS

CONTENTS

INDUSTRIAL ATTITUDE TOWARD SCIENCE FOUNDATION

ALL industry, and especially that part of it which is conscious of and is active in the application of new technological developments, should support a properly organized national foundation to use federal funds in support of basic research and the training of scientific personnel.

Science and technology advanced tremendously during the past five years, but this advance was achieved on a forced and rather artificial basis. A shortage of technically trained manpower was offset by working extremely long hours. A shortage of the normal type of revenues for scientific education and basic research in non-profit institutions was offset by tremendous federal expenditures for war research in those same institutions. Now that the war is over, we will begin to feel keenly the shortage of scientfic personnel and the shortage of funds for basic research.

It is in the interest of industrial technology that a National Research Foundation be established and that it be guided by an agency composed solely of individuals selected on the basis of their broad understanding of the unique nature of scientific research and education. I urge it in the public interest for reasons of national security, national health and national prosperity. I say this because I know of no other source of funds to augment those now available. Crushing taxation of high incomes and artificially low interest rates have created the situation and the colleges have no other place to turn.

But the problems of national support for science and applied technology can and should be met on their own merits without inserting in the legislation any provision which, by indirection, might constitute a modification of the economic status of private industry research and affect its relation to government. Scientific advances made within the framework of our present political economy and made mostly in private enterprises and by persons trained in private enterprises, helped win us a great war. Dislocation or disruption in private industry's incentives for applying technology might lose us another.

If federal funds are to be applied in technological fields previously left to private, competitive enterprises, it is extremely important that the patent policies be set in such a way that they will not be regarded as threats to the continued well being of private businesses. If the foundation does enter into contracts for the execution of applied research, the legislation under which it operates should give it latitude to deal with the patent question in accordance with the separate need of each different situation.

The basic plan underlying the proposal for a National Research Foundation cannot be settled without facing squarely the possibility of some allocation of funds to fields ordinarily described as applied technology, in which private enterprises in search of profit are risking venture funds and seeking patent protection. It follows that the legislation should be shaped in such a way as either to encourage or flatly discourage the participation of these private enterprise. It would not be in the public interest to set up legislative hurdles impeding the participation of any private enterprise in a national effort to advance science and technology, and I urge that the patent policy of the foundation be charter along the lines recommended by Dr. Bush.

Bruce K. Brown, Standard Oil Co. (Ind.), at a panel discussion "Research, Government and You," Chicago, Nov. 8, 1945.

CHEMICALS FROM WOOD

AMERICA's vast synthetic organic industry, which has been built on coal and petroleum, must look to the products of farm and forest for its survival when coal and oil supplies dwindle and their cost rises. Although the imminence of the exhaustion of coal may well be discounted as far as the immediate future is concerned, from the point of view of national economy it is still desirable that the day of reckoning should be postponed.

Exploration of the potentialities of wood can do much to offset the danger of depletion of the coal supply. By the proper husbanding of the forests, it should be possible to obtain carbon indefinitely, or at least as long as human life can be maintained on this planet.

One wood byproduct which should be studied intensively is lignin which presents an almost insuperable disposal problem to the paper industry in the manufacture of paper pulp from wood. Millions of tons are available each year. Lignin, a material of complex structure, is an organic substance and hence capable of chemical changes. These should, and must be, exploited for profit and utility

The immense possibilities of wood as a source of materials for synthetic industry were illustrated, by the accomplishments of Nazi Germany in this field. The Germans lacked sufficient coal and petroleum so they turned to the forests of Europe for substitute products. Making cellulose the cornerstone of German aggression, the Nazis proceeded to develop processes for transforming this inexhaustible raw material into food and fodder, textile fibers, solid and liquid fuels to sustain a long and almost successful war.

They produced at first sugars for animal consumption and later for the human diet and succeeded in satisfying the energy requirements of the Axis countries. Furthermore, by fermenting these sugars they cultivated yeast containing as much as 55 per-

cent protein. In 1939 they were operating nine factories with a production capacity of 150,000 tons of crude sugar and planned to quadruple this shortly thereafter.

Germany and her satellites also turned out enormous quantities of artificial fibers. By 1941 they were producing 672,000 tons of artificial wool and 588,000 tons of rayon.

Sweden's use of lubricants made from wood to maintain its motor traffic, and the production of alcohol from sulphite pulp liquor and also from sawdust on the West Coast of the United States, are other examples of wood products' varied uses.

These examples serve to revive our interest in the waste products of the lumber industry, and are a challenge to research and technology to improve our national economy.

—Lucas P. Kyrides, Monsanto Chemical Co., before Kansas City Section, American Chemical Society, Nov. 13, 1945.

PETROLEUM vs. PLUTONIUM

Under the compelling stimulus of war large-scale sources of atomic energy have been developed. In the pure form required for atomic bombs, U-235 is far more costly than platinum. Plutonium is similar to U-235 but is a relatively inexpensive substitute. It is in the production and utilization of plutonium that petroleum may find a competitor.

Yet plutonium must be manufactured. The raw materials for this man-made element are pure graphite and uranium. In the production of plutonium ordinary uranium suffices. Blocks of graphite and uranium are stacked checkerboard fashion until a large pile is obtained. When larger than a certain critical size, this pile undergoes spontaneous atomic combustion and releases prodigious amounts of heat and intense radiations. Part of the uranium disintegrates, while an equal amount is changed to plutonium. The graphite is not used up but simply moderates the reaction. The plutonium can be separated chemically and fed back into the pile to produce additional heat and radioactive radiations, or it can be used in atomic bombs or in compact sources of atomic energy.

Can atomic power compete with petroleum, coal and water power on an economic basis? Too many unknowns are involved to allow other than speculation.

Since coal is the most economical fuel for large installations, it would appear that natural uranium piles may compete with coal, particularly in the generation of electric power. The piles could be located near the populated areas but sufficiently remote to prevent radiation hazards. The heat released would be used to produce steam to drive turbo-electric generators. By using uranium that has been enriched in U-235, or to which plutonium has been added, the size of the pile can be considerably reduced. The use of heavy water as a moderator in place of graphite also allows substantial reduction in size.

With the decrease in size of power units, the competition with petroleum would probably begin in replacing fuel oil in large transports and naval vessels. A distinct advantage for naval vessels would be that "refueling" would be infrequent. Shielding from the radiations would be a major problem and would add considerably to the weight and size of the units. Such appli-

cations of atomic energy might be entirely ruled out on this basis alone.

In order to compete seriously with diesel oil and gasoline, atomic engines must be adaptable to trains, trucks, planes, and automobiles. For these purposes the shielding problem would be most acute. The compactness gained in using atomic fuel might be more than offset by the large amount of shielding required. Of course, all of these considerations have been limited to the source of atomic energy now known—that is, to nuclear fission of heavy elements. It will be recalled that the consolidation of light elements into medium-weight elements releases comparable amounts of energy. While such nuclear syntheses have never been accomplished on a large scale, they have been achieved in minute amounts in the laboratory. If future research extends the range of available atomic energy to include the light elements, many of the above limitations may be removed. In addition, these light elements would probably be far more plentiful than the relatively scarce fissionable elements.

Within the bounds of available information it would appear that petroleum and coal will probably continue for at least another generation as the primary sources of energy for transportation and heating. Water power and coal will probably generate most of the electricity during the next 50 years. While atomic energy may gradually enter as a competitor, its most extensive applications will probably be in new fields of human endeavor. Industrial processes at extremely high temperatures, ultra-high-speed transportation, the production of radioactive materials for industrial and medical purposes as well as for scientific investigations, the manufacture of rare elements by transmutation, and the treatment of materials by radiation are among the more likely specialized uses of fission energy in addition to the continued production of atomic explosives.

Few of us will live to drive atomic automobiles or fly jet planes powered by nuclear energy. When this time arrives, there will still be a petroleum industry, but it may have changed rather remarkably in character. Instead of petroleum being primarily used for fuel, it will be the raw material for all kinds of organic substances.

It seems a waste to burn hydrocarbon molecules when they can be converted into valuable compounds like synthetic rubbber, toluol, polymerized lubricants, plastics, and medicinal substances. The war has emphasized the importance of petroleum as a source substance in organic synthesis. An increase in the availability of atomic energy together with an increase in the knowledge of the organic chemistry of petroleum should result in considerable expansion of the chemical utilization of petroleum.

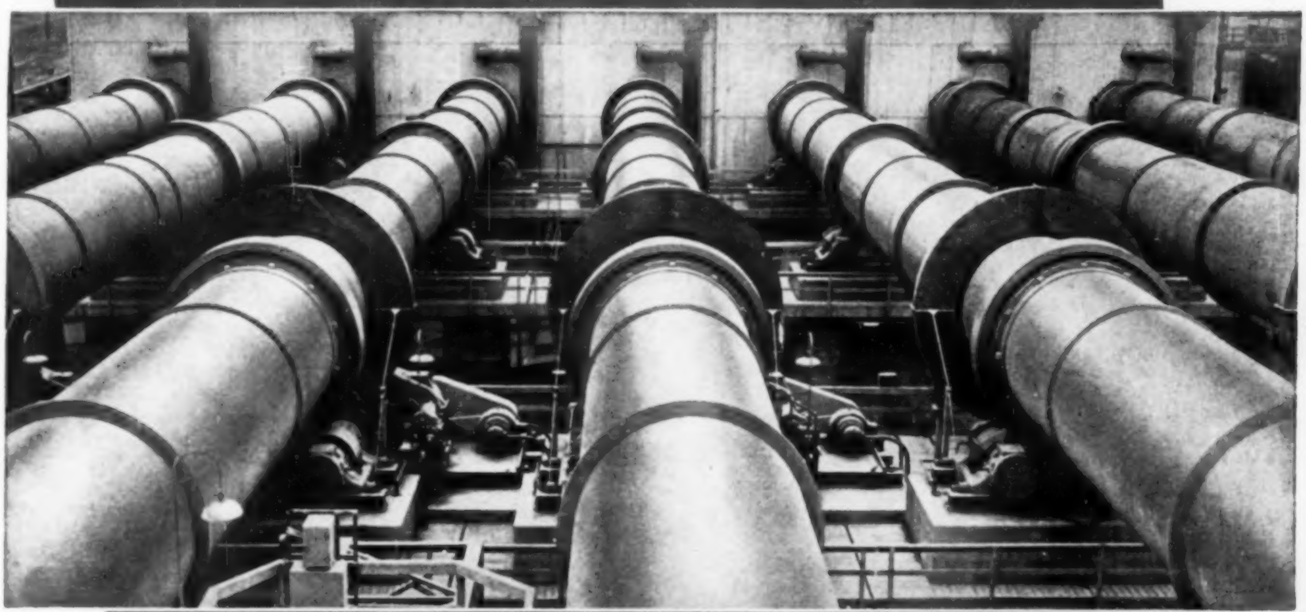
—Clark Goodman, Massachusetts Institute of Technology, before American Petroleum Institute, Chicago, Nov. 15, 1945.

THE USELESSNESS OF RESEARCH

There is no such thing in chemistry as useless fundamental research.

It was years of apparently useless investigation, conducted at the University of Minnesota solely for its academic interest, that enabled the Minnesota scientists to speed vitamin E synthesis, once they tackled

KNOWN EVERYWHERE



USED EVERYWHERE

WE BUILD

Kilns
Coolers
Dryers
Slakers
Scrubbers
Jaw Crushers
Gyratory Crushers
Reduction Crushers
Crushing Rolls
Ball Mills
Rod Mills
Wash Mills
Feeders

Whether in mining, cement, lime, chemical processing or any industry using rotary kilns—Traylor Kilns are known everywhere and used everywhere. Over 45 thousand feet of Traylor Rotary Kilns are in use in the United States and foreign countries.

Traylor engineers constantly build into these machines all the latest improvements that meet and often anticipate the requirements of operators for increased efficiency and lower operating costs.

Our representative will be glad to call—at your convenience—to tell you in detail about . . . the all-welded steel shell . . . the high efficiency of design . . . the economy of operation . . . the single roll supports . . . and the many other features and advantages that are to be found in Traylor Rotary Kilns.

If you prefer, just ask for Bulletin #115.

TRAYLOR

ENGINEERING & MANUFACTURING CO.

MAIN OFFICE AND WORKS — ALLENTOWN, PENNA., U.S.A.

NEW YORK CITY, 3416 Empire State Bldg. · CHICAGO, 2051 One La Salle St. Bldg. · SALT LAKE CITY, 101 West Second South St. · LOS ANGELES, 919 Chester Williams Bldg.

B. C. EQUIPMENT CO., LTD., 551 Howe St., Vancouver, B. C. · CANADIAN VICKERS LTD., P. O. Box 550 Place D'Armes Station, Montreal, Canada

Export Department—104 Pearl St., New York City. Foreign Sales Agencies: London, Lima, Rio de Janeiro, Buenos Aires, Santiago, Antofagasta, Oruro, Montevideo, La Paz

the problem. The conclusion to be drawn is that any research which is fundamental is worth doing, however "useless" from a practical point of view it may seem at the time, for it can never be predicted when some of these useless researches will assume great importance and will form the starting points in an attack upon some urgent commercial problem. So the early useless work thus does not have to be done when the urgent related problem appears, and much time is saved because the background has already been constructed.

Two seemingly unrelated lines of research contributed to the rapid progress made on vitamin E. The first, began in 1922, concerned the reactions between two types of compounds, alkylated quinones and metallic enolates. The second dealt with benzene products called polyalkylbenzenes and polymethylbenzenes. As a result of these studies, a great many new compounds were prepared.

Later, when the probable structure of the vitamin E factor alphatocopherol was suggested, the chemists found that not only was it a simple matter to carry out model researches in support of this theoretical structure, but that in many instances the model researches did not have to be carried out—they had been performed already and the resultant compounds were on the laboratory shelves.

As a result, the group knew exactly how to synthesize alphatocopherol after working but a month or two on this specific problem. Thus the work of over 15 years, done purely for its academic interest, made possible the synthesis of alphatocopherol in a matter of less than six months.

Lee Irvin Smith, University of Minnesota, before Akron Section, American Chemical Society, Dec. 13, 1945.

PATENT CHANGES PROPOSED

THE PATENT litigation process is becoming increasingly difficult because of the profound character of modern science and the need for technical assistance in the determination of the technical scientific questions posed by most patent cases. The courts must be aided either by impartial experts of unquestioned competency or by the establishment of separate patent tribunals. These tribunals might be composed of sitting judges who are specially fitted for this type of service, or entirely new courts composed of men chosen specifically for their qualifications in the patent field might be set up.

The patent is only as good as it can be demonstrated to be in litigation. While the past decade, with its reform of federal procedure, has seen a quickening of the pace of litigation, there are still many phases of the litigation process that require improvement, particularly that relating to patent accountings.

Extensive changes also are needed in the administrative procedure of granting patents. Although the system is fundamentally sound, it can and should be simplified to facilitate and speed up the issuance of patents so that the disclosure to the public may be expedited and the patentee may begin to employ his reward for the disclosure at the earliest possible time. For example, there is a definite need for simpli-

Lower Distribution Costs for your Products—

5 New Bulletins report successful Load-Transportation Methods throughout the Process Industries

News for Executives! These 5 interesting Bulletins describe Industrial Logistics—today's method of transporting Process Industrial Loads in Master Units, at increased speed and at greatly-reduced costs.

Types of containers are discussed individually—Boxes, Barrels, Bags and Bales—with profuse illustrations from photographs demonstrating applications of Pallets and Skids in the complete movement of goods from Supplier—during all stages of Manufacturing—through Distribution to final customer.

Interested Executives are invited to request all 5 Booklets, without obligation. Please use the coupon, or write or wire for an immediate interview with your nearby Elwell-Parker Materials-Handling Consultant.

The Elwell-Parker Electric Company, 4228 St. Clair Ave., Cleveland 14, Ohio.

Clip, attach to your letterhead, and mail to Elwell-Parker, Cleveland:—

Send your 5 Industrial Logistics Bulletins to

Name ____________________

Title ____________________

Firm ____________________

City __________ State __________ C&ME

ELWELL-PARKER

POWER INDUSTRIAL TRUCKS

Established 1893

fication of the problem of searching the pertinent literature by which the novelty of an invention is tested.

Besides the problem of identifying the novel features of an invention proposed for patenting, there also is the task of measuring the discernible advance against the standard of invention to determine whether invention is present in the progressive step disclosed by the patent application. This problem we hope to meet by the expression of a set of clarifying rules.

Most discussed of all patent problems is that of the so-called abuse of patents. Legislation frequently is proposed for the forfeiture of misused patents, with heavy penalties to be imposed for anti-trust schemes devised under the apparent sanction of patents. As long as these abuses exist, they will create a loud protest that exaggerates the extent of the abuse. Remedies must be devised to permit the patent owner the fullest exploitation of his invention and still protect the public against devices that interfere with the freest possible enterprise.

Enlightened consideration of all these problems will yield remedies that are beneficial to the patent system and need create no apprehension as to its survival.

Casper W. Ooms, United States Commissioner of Patents, before Chicago Section, American Chemical Society, Dec. 14, 1945.

THE WORLD FERTILIZER MATERIALS SITUATION

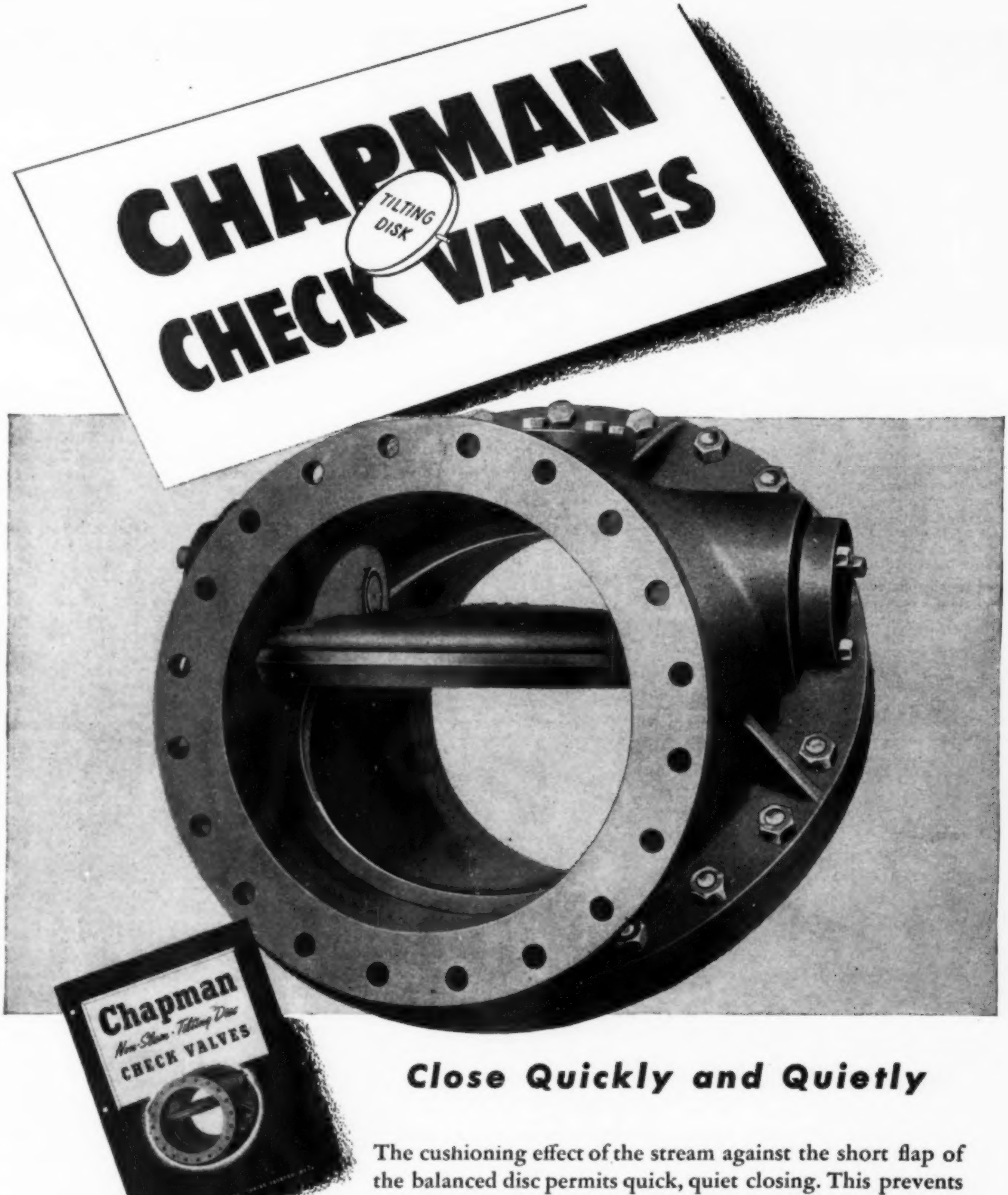
Notwithstanding temporary shortages of certain materials, inadequate labor, unsatisfactory transportation conditions, bag shortages, and the like, the wartime record of fertilizer production in the United States is outstanding. While many farmers would have gladly purchased more fertilizers if materials had been available, a review of the over-all statistics for the war years shows a plant food production increase 84 percent during the war period.

This fine record of domestic accomplishment does not mean that we live in a world free of fertilizer supply problems. Global supplies are short and deficiencies will hamper rehabilitation of agriculture in the war-torn areas during the coming season and possibly 1947. It has been roughly estimated that the current world shortage of nitrogen exceeds 300,000 tons annually; of phosphates 500,000 tons P_2O_5; and of potash, 175,000 K_2O equivalent.

In the case of nitrogen, a deficiency exists of almost 20 percent; of phosphates, 10 to 15 percent; and of potash, under 10 percent. These estimates exclude Asiatic requirements which are chiefly for nitrogenous materials. The magnitude of the Asiatic deficiencies can be appreciated if it is recalled that the prewar Japanese Empire had a nitrogen capacity of approximately 400,000 tons, whereof a large share of the output was required for home consumption.

The permanent cure for a shortage is to raise output. There is idle nitrogen capacity in Europe but nitrogen plants need coal and coal is the Number One priority problem in Europe. First consideration for the winter season will be to provide fuel for keeping the population from freezing. At the close of the winter period it will be too late to accumulate adequate nitrogen supplies for the 1946 crop year.

Percentagewise, the world potash shortage



Close Quickly and Quietly

The cushioning effect of the stream against the short flap of the balanced disc permits quick, quiet closing. This prevents water hammer and resultant destructive stresses in pipe lines. Head losses are cut to about a quarter of those caused by ordinary types of check valves. Substantial power savings are possible when these valves are installed on pump discharge lines.

Send for new bulletin containing complete information.

The Chapman Valve Mfg. Company, Indian Orchard, Mass.

CHAPMAN NON-SLAM CUSHIONED CLOSING **CHECK VALVES**

is smaller than that of nitrogen and phosphates. Coal is required for production, for mining and refining operations. The outlook for German exports is discouraging.

Little immediate relief is in sight for meeting the world phosphate deficiency. As in the case of nitrogen, the coal supply problem is a limiting factor in the North African phosphate fields. While North Africa is behind schedule on exports, the trend of deliveries has improved in recent months. Deliveries of rock from Nauru and Oceania at about prewar levels may be delayed 18 months to replace gear damaged by the Japanese early in the war.

J. W. Wiseman, Civilian Production Administration, before National Fertilizer Association, Atlanta, Ga., Nov. 13, 1945.

PLUTONIUM CHEMISTRY

THE first pure chemical compound of plutonium, free from carrier material and all other foreign matter, was prepared by B. B. Cunningham and L. B. Werner at the Metallurgical Laboratory in Chicago on August 18, 1942. This memorable day will go down in scientific history to mark the first sight of a synthetic element, and, in fact, the first isolation of a weighable amount of an artificially produced isotope of any element.

As is now well known, large quantities of plutonium are available as the result of the operation of the chain-reacting units at Clinton and Hanford. Using plutonium from these sources a number of groups have investigated intensively the chemical properties of plutonium.

The work has established that plutonium has the oxidation states VI, V, IV, and III and that the lower oxidation states tend to be more stable than is the case for neptunium. A large number of compounds of plutonium have been prepared and their properties determined and it is fair to say that the chemistry of plutonium today is as well understood as, or better understood than is that of most of the elements in the periodic system.

General conclusions from this work are, then, that plutonium and neptunium are similar in chemical properties to uranium with an increase in stability of the lower oxidation states in going toward plutonium.

In most ways, plutonium is the most interesting element in this new series and therefore a description of the achievements which have been accomplished in the chemical field with this element is worthwhile. Since the time of its inception, the Metallurgical Project had as its principal goal a method for obtaining in a free state sizable quantities of Pu^{239}. This problem was comprised of two major components, which were to a large extent unrelated. The nature of the development programs was as different as were the groups of research workers charged with their commission. The first major part of the program was the development of a chain-reacting structure which would produce the Pu^{239} in a uranium matrix, while the second part was the design of a method for separating the plutonium from the uranium and the highly radioactive fission products formed concurrently.

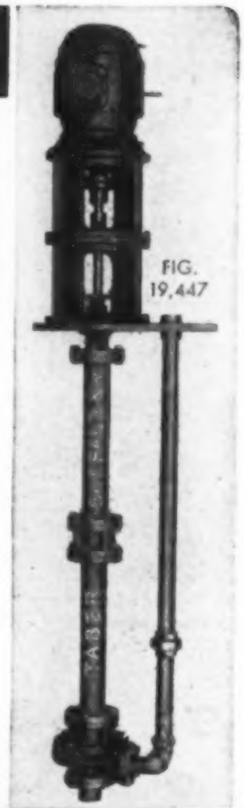
The problem of designing a process for separating plutonium was without precedent from almost every standpoint. No one had ever seen any plutonium at the time that

plant design was under consideration. The chemical properties attributed to the element at that time had been deduced solely from what might be termed secondary evidence (experiments on the tracer scale).

The novelty of the problem was enhanced by the fact that not only was Pu^{239} to be the first artificially produced isotope to be seen but that as an element it fell beyond the confines of the classical periodic system. These curious conditions, in themselves, would not necessarily produce serious obstacles were they not coupled with other aspects of the problem of an unconventional nature for industrial scale operation. Both the plutonium and the fission products from which it was to be separated would be present in extremely small concentrations in the uranium. These separations would require specialized techniques. The formidable feature of the undertaking was, however, that these minute amounts of the fission products elements would in turn have to be separated from the plutonium to the extent that only an amount of the order of one part per million of each would remain. To add to the complications, the separations process would have to be carried out entirely by remote control, because of the staggering levels of gamma-ray activity associated with the fission products. As a result, it was imperative that the process be adaptable to simple equipment that would require a minimum of maintenance and that the limits of control be not too stringent.

Although four methods for chemical separation were examined, volatility, adsorption, solvent extraction and precipitation, the process finally chosen was a precipitation process. The process depends on the co-precipitation of the plutonium along with a "carrier" precipitate, a procedure which has been commonly used in radio chemistry. One of the most interesting and awe-inspiring aspects in the development of this process was the necessity for the testing of the process at a time when only microgram amount of cyclotron-produced plutonium were available. It was necessary to test the process at concentrations corresponding to the full level of Hanford plant operation and therefore the experiments had to be conducted on the ultra-microchemical scale of operation, which employed volumes of only microliters. This involved a scale-up between these experiments and the final Hanford plant by a factor of about 10^{10}, surely the greatest scale-up factor ever attempted. In spite of these difficulties, the chemical separation process at Hanford was successful from the beginning and its performance exceeded all expectations. High yields and decontamination factors (separation from fission product activity) were achieved in the very beginning and have continued to improve with time.

There are carried out in all some 30 major chemical reactions involving hundred of operations before the plutonium emerges from the process. The plants themselves defy description with their massive structures and their intricate maze of equipment, piping and remotely operated controls. The preliminary design of these plants was underway at a time when Major General Leslie R. Groves, who was in charge of the entire Atomic Bomb Project, remarked, with justification, as he was being shown the microscopic bit which represented the world supply of plutonium: "I don't see



anything." This remarkable program of investigation with submicroscopic quantities marks only one of a large number of amazing and, so far unheralded, achievements of the men of chemistry who worked on the atomic bomb project.

Glenn T. Seaborg, University of California, before Chicago Section, American Chemical Society, Evanston, Ill., Nov. 16, 1945.

REACTIONS OF CUPRENE WITH HYDROGEN HALIDES

SEVERAL investigators have shown that the solid polymer of acetylene, called "cuprene," will absorb oxygen when exposed to air. Cuprene made by the action of alpha particles from radon contained nearly 25 percent oxygen after 12 days. Cuprene made from electric discharge in the all-glass ozonizer contained 4.85 percent oxygen after being in contact with oxygen gas for a period of one month. The difference in the behavior of the two products must be due to some variation in the internal structure of the two solids. The primary fact of interest is the consideration that cuprene will absorb oxygen and it seemed pertinent to investigate the possibility that other gases might also be absorbed by solid cuprene. Nitrogen and chlorine were found not to react with the polymer. In the present research acetylene polymer or cuprene was prepared by electric discharge in an all-glass, cylindrical ozonizer of usual construction. The solid polymer was found to react with the hydrogen halides to the following extent, expressed in moles of hydrogen halide per mole of acetylene: 0.154 HCl; 0.085 HBr; 0.000 HI. The hydrogen chloride product was black which changed on exposure to air to a deep brown. The hydrogen bromide was not quite as black as the hydrogen chloride product; in air it did not change as markedly in color as did the HCl product. No absorption of hydrogen iodide was found.

George Glockler and A. E. Walz, State University of Iowa, before The Electrochemical Society, Chicago, Oct. 5, 1945.

CHEMICAL CLEANING OF POWER AND PROCESS EQUIPMENT

A LARGE percentage of all process equipment loses operating efficiency during service due to the building up of various deposits. Some form of cleaning is required. Where chemical cleaning can replace manual cleaning there is a great saving in time and labor and generally the elimination of the necessity of dismantling the equipment. It has also been found that where chemical cleaning is applicable it generally provides a more complete and thorough removal of the deposits and foreign matter and also saves a good deal of wear and tear or occasional damage which occurs in dismantling equipment for manual cleaning.

Development of chemical cleaning has resulted from a combination of chemical and engineering research together with full scale experimenting. A good deal of the work has been simply a matter of developing chemical products which will remove the average different kinds of deposits and then of working out practical methods of application which are adaptable to most actual plant conditions. As the deposits of foreign matter which build up in equip-

PEERLESS PUMPS

UPON THE STRONG, GREATER STRENGTH IS BESTOWED

A Statement by
FOOD
MACHINERY
CORPORATION
in regard to
Dayton-Dowd

An important advance in the history of the pumping industry now makes available a new conception of integrated pump service to customers.

Dayton-Dowd, long associated with sustained high quality—a distinguished name on centrifugal pumps—has become an integral part of the Peerless Pump organization.

To the prestige and enviable reputation of *Dayton-Dowd* have opened new horizons of progress and wider scope for service by alliance with the nation-wide facilities of *Food Machinery Corporation.*

Thus, to purchasers of both Horizontal and Vertical centrifugal pumps is available the coordinated engineering and research leadership that produced the FMC *"Water Buffalo"*—the first battle-proved amph-trac.

This merger of broad installation-wise experience, modern technical research and alert engineering talent assures our customers for all types of pumps that the name *Peerless* stands as the guarantee for quality and progress.

•

Peerless performance—all that the name implies.

PEERLESS HORIZONTAL PUMPS

=formerly Dayton=Dowd

Type A—Dual Drive

Type T—Turbine

Type A—Large Capacity

F.M.C. builds with STEEL

PEERLESS PUMP DIVISION—FOOD MACHINERY CORPORATION

Factories: Los Angeles, Calif. Quincy, Illinois. Canton, Ohio.

WAR-TIME BUILDERS OF THE VICTORIOUS "WATER BUFFALO". PEACE-TIME BUILDERS OF TOP-FLIGHT PUMPS

ment are of greatly varying nature and quantity, each problem is slightly different. So no exact method outlined will meet all conditions. However, from tabulating numerous applications and constantly combining laboratory and field observations, it has been possible to develop a series of rather standardized methods to meet most requirements.

Two factors which impair operation of a plant are film between the steam and the outside of the tube, and scale between water and inside of the tube.

Considering first the film or scale on insides of the tube the variation of condensing water conditions give many different combinations of hard water scales, mud, sludge, algae growth and sometimes oil from contaminated waters. Most of these scales or deposits can be removed by introducing into the water side of the condenser a solution of acidic nature. Scale removal requires from 2 or 3 hr. up to periods as long as 24 hr. For the average job about 10 percent of the acidic material in 90 percent water is run in through the top of the condenser. It may generally be done as a cold operation but for difficult jobs sometimes the solution is heated, care being used to bring up to a temperature of not over 140 deg. F., raising the temperature slowly to prevent strains on the condenser. For safety to the equipment it is advisable to use a well inhibited material to keep to the minimum any possibility of attack on the equipment. As a means of determining the degree of completion of the descaling an occasional titration of the solution in the condenser is utilized.

The outsides of the tubes or the steam side of the condenser also frequently accumulate a film which is very resistant to heat transfer as it is often of oily nature. A method rather similar to the above except utilizing an alkaline type material which has oil and grease emulsifying properties has proved very successful. This is almost always done as a hot operation as the cleaning solution will remove the film much more quickly and thoroughly at about 140 deg. F. than by a cold soak.

While the function of lubricating oil coolers is quite different from that of surface condensers they are also subject to accumulation of deposits and their chemical cleaning is conducted rather similarly to that for surface condensers. On the oil side of a lubricating oil cooler very appreciable accumulations of sludge and broken down lubricating oils take place. By breaking the regular connections and introducing a pump and a small tank a solution of a heavy-duty alkaline type cleaning material can be given a constant circulation for several hours. It is highly advisable to heat the solution to about 160-180 deg. F. during the circulation.

The water side of the oil cooler may be descaled with an acidic material in a rather similar manner to that described for surface condensers and heat is generally not required.

A typical application is the cleaning of the tube bundles from heat exchangers such as a lubricating oil cooler or a fuel oil heater. Sometimes such equipment cannot be well cleaned by the circulating methods. In that case the tube bundle is withdrawn from the equipment and a heavy-duty hot oil-removing cleaning solution is applied by

the steam gun. The cleaning solution is thus forced into the various parts of the bundle including the inner rows of tubes which cannot be reached by manual cleaning, and as the solution loosens the oils, the force of the steam blast knocks off the foreign matter.

As the conditions which cause foreign deposits in equipment vary greatly the advisable time intervals for cleaning respective pieces of equipment vary in different plants and localities. It is not so important to aim for a schedule and then to modify it as experience indicates necessary.

While many of these operations have now been standardized to a high degree of effectiveness there are still an inviting number of industrial cleaning operations on which large improvements are yet to be made and on these much technical and practical study is being given.

H. Liggett Gray, Oakite Products, before New York Section, American Society of Mechanical Engineers, Nov. 16, 1945.

FOREIGN LITERATURE ABSTRACTS

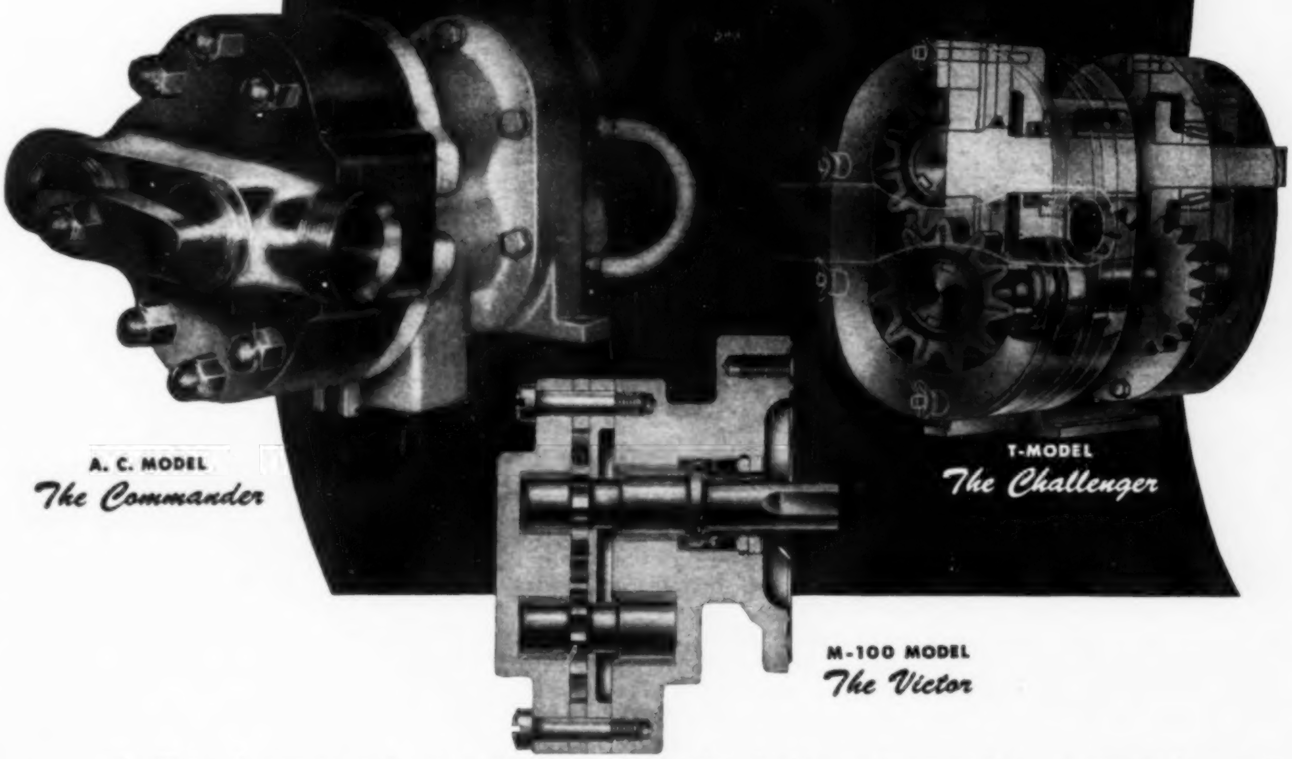
SULFANILAMIDE DERIVATIVES

A STUDY was made of sulfanilamide derivatives containing different radicals in the sulfonamide group. Introduction of a diethylaminoalkyl radical or of methylenecarboxylic acid into the sulfonamide group destroys the therapeutic activity of the preparation. Introduction of aminophenyl radicals leads to active preparations, their activity increasing depending on the position of the amino group in the following sequence $o < m < p$. Introduction of hydroxyphenyl radicals into the sulfonamide group lowers the activity of the sulfanilamide. The influence of the position of the hydroxy group upon the activity of the preparation is expressed by the same sequence as in the case of the corresponding amino derivatives. Introductions of carboxyphenyl radicals into the sulfonamide group decrease the therapeutic action of the preparation against cocci infections. The influence of the position of the carboxyl group upon the activity of the preparation is expressed by another law, viz.: the activity decreases with a change in the position of the carboxyl group following the sequence $o > m > p$. A preparation was found which is active in the treatment of experimental gas gangrene.

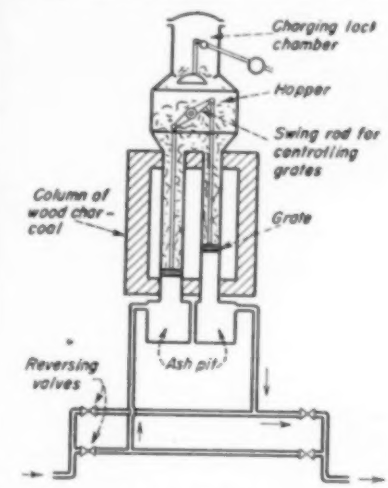
Digest from "Derivatives of Sulfanilamide" by M. V. Rubtsov and V. M. Fedossova, *Zhurnal Obshchei Khimii* XIV, No. 7-8, 848-856, 1944. (Published in Russia.)

PRODUCER GAS FOR GASEOUS CEMENTATION

GAS USED for cementation must be free of sulphur and should therefore be prepared in gas producers using wood or wood charcoal. When the latter is used, a strong injection of steam is recommended to produce a hydrogen-rich gas. It does not matter if it is humid and contains carbon dioxide gas, since it is later reduced by passage over a column of wood charcoal maintained at 1,000 deg. by external heat-



ing. The furnace is fairly narrow so that the heat is transmitted satisfactorily throughout the mass. It consists of two tubes of non-oxidizing steel. To permit recharging during operation, there is a hopper above the tubes and a cap-and-cone charging lock chamber. Air introduced during charging or the moisture of the wood charcoal is prevented from changing the composition of the cementation gas by placing this charging device in the middle of the reduction circuit, that is to say, at the upper part of the two columns so that the air and the moisture react over the wood charcoal in passing through the column, whatever the direction of the operation, since the gas enters at the bottom of one tube and leaves at the bottom of the other. This two-tube device must be used in order to allow the descent of the charges, for if there is only one tube with a hopper above and an ashpit below, the gas must necessarily enter above so that the air and moisture of the fresh carbon



have to react before the gas at the bottom arrives at the outlet. Since the gas is in equilibrium toward its outlet, the carbon would not react any more and the ash would collect above in the middle of the furnace. Regular exhaustion of the carbon in the two columns is provided by reversal of operation by means of four valves which are manipulated once a day. The carbon descends and the ashes are eliminated by means of a grate. The heat outside the tubes is applied electrically by means of carborundum rods. The gas is cooled and filtered at the outlet of the furnace.

Digest from "Gaseous Cementation" by J. Pomey, *Chimie et Industrie* **54**, No. 2, 97-104, 1945. (Published in France.)

FIBER FROM VEGETABLE ALBUMEN

So FAR all attempts to make synthetic wool, which has all the properties of natural wool, from cellulose and its derivatives have not been entirely successful. Research work has therefore been directed to the preparation of a wool substitute from albumen substances since the latter should yield a fiber which would have properties very similar to those of natural wool. Up to the present casein has served as raw material for preparation of synthetic wool but this requires the consumption of large quantities of food products. It would be preferable to use another source of albumens which is

either not used at all at present or else is not utilized completely. It was found possible to use the oil cake and coarsely ground seed of the castor plant for the preparation of a pure albumen which is suitable for conversion to staple fiber and to plastics. The albumen of this plant is particularly interesting since it cannot be used as food for stock (due to its toxicity) and it is available in large quantities from the manufacture of castor oil which is used for aviation motors. The oil cake and coarsely ground seed of the castor plant obtained in the usual method by roasting the seeds and steaming them at a high temperature, give an albumen which is denatured and yellow in color. Pure white albumen which is not denatured is prepared by using white coarsely ground seed of the castor plant obtained without thermal treatment of the seeds. The salt method is the most practical and economical for extraction of the albumen from the cake and coarsely ground seed. This method permits easy extraction of the albumen in large quantities and in the dry form.

Digest from "Preparation of Vegetable Albumen from Castor Plant" by M. C. Tartakovski and V. D. Matveev, *Zhurnal Prikladnoi Khimii* XVII, 4-5, 274-281, 1944. (Published in Russia.)

AMMONIA AND HYDROGEN SULPHIDE FROM GAS

Crude gas from coke plants, after separation of the tar, contains approximately 700 g. H_2S, 300 g. NH_3 and 3,900 g. of CO_2 for each 100 cu.m. These compounds are easily eliminated and separated due to their reactivity. Total elimination of ammonia and hydrosulphuric acid is achieved in gas and in coke plants. In practice there is no separation of CO_2 which generally accompanies these gases as an inert component, since it does not attack the tubings and apparatus of the plant and does not have toxic properties. In gas plants ammonia is usually separated by washing with water. This also eliminates part of the hydrosulphuric acid and carbon dioxide with formation of ammonium salts. Each liter of the resulting solution thus contains 100 g. of NH_3, 3 g. of H_2S and 120 g. of CO_2. The rest of the hydrosulphuric acid is eliminated while the carbon dioxide remains in the gases. Another method of elimination is by direct washing of the crude gases, after separation of the tar with warm sulphuric acid, and formation of ammonium sulphate. The Thyolox process is also used in coke plants. This method uses alkali arsenates as the wash liquor and results in elemental sulphur from the crude gases. The use of the ammonium soda process for preparation of sodium bicarbonate by washing the crude gases with a solution of sodium chloride permits a 70 percent recovery of the common salt. Use of 45 percent oxygenated water makes it possible to make ammonium sulphate directly from the hydrosulphuric acid and ammonia in the gases with an 82.5 percent recovery of the oxygenated water. The ammonia in the gas can be totally converted to ammonium sulphate by washing the gases with a paste of gypsum in water.

Digest from "A Contribution to the Utilization of Ammonia and Hydrosulphuric Acid Contained in Crude Gases", by A. Samtleben, *Oel u. Kohle.*, 40, 63, 1944. (Published in Germany.)

CHEMICAL ENGINEER'S BOOKSHELF

LESTER B. POPE, Assistant Editor

Al_2O_3

C **I-364**

N_2

In the Serpex process for refining aluminous ores the electric resistance furnace charge is heated to 1,600 to 1,800°C. The aluminum nitride is then digested in an autoclave under steam pressure.

(a) $Al_2O_3 + 3C + N_2 \rightarrow 2AlN + 3CO$

(b) $2AlN + 3H_2O \rightarrow 2NH_3 + Al_2O_3$

C. L. Mantell, Chem. Met. Eng., **35**, 746 (1928) *44*

A typical entry in the "Encyclopedia of Chemical Reactions"

REACTION REFERENCE

Encyclopedia of Chemical Reactions. Vol. I. *Compiled and edited by C. A. Jacobson. Reinhold Publishing Corp., New York. 804 pages. $10.*

A monumental work has been undertaken. It is proposed to publish a series of volumes that will contain all, or nearly all, published chemical reactions, described briefly and expressed in equation form. Volume I, now available, contains the published reactions of eight elements: Aluminum, antimony, arsenic, barium, beryllium, bismuth, boron and bromine. The entire system is alphabetically arranged first as to formulas of reactants and next as to reagents. The cut above shows a typical entry under aluminum. In this particular case Al_2O_3 is reactant; C and N_2 are reagents; I-364 is the serial number indicating entry 364 in Vol. I; 44 is the identification of the abstractor who took the data from the original source which, in this case, was an article by Mantell in *Chem. & Met.*

Value of the finished encyclopedia is obvious. Chemical engineers and chemists will refer to it in conjunction with all sorts of industrial and theoretical research work.

CHEMICALS FOR AGRICULTURE

Chemicals and Food Production. *By Philip H. Groggins. Available from Prof. Robert W. Schiessler, The Pennsylvania State College, State College, Pa. 115 pages. $2. (Make checks payable to Phi Lambda Upsilon.)*

Reviewed by Gordon W. McBride

This summary of information on chemicals utilization in food and agriculture is from the Nineteenth Annual Priestly Lectures of May 1945. It has been well presented by the former head of the Chemicals Division of the War Food Administration. The content is both historical and technical with a wealth of statistical material. Although the book has no index, it is arranged in a very logical manner and should serve as a useful reference volume for many years to come.

There are three sections in the book, the first dealing with fertilizer chemicals, the second dealing with insecticides and fungicides for crop and animal protection, and the third dealing with chemicals for processing, preserving, and packaging foods. Two or three miscellaneous chemicals got into section three which might normally be sought in section one or two. These include weed killers, legume inoculants, and plant hormones at the end of section three.

Within each section the chemicals which are most important are discussed briefly as to relative quantities employed, qualities required, and general conditions of use. Statistical information is presented wherever possible.

OVERDUE

American Petroleum Refining. *Third Edition. By H. S. Bell. D. Van Nostrand Co., New York. 619 pages. $7.50.*

With a good blend of theory and basic principles, design and process conditions, the overdue third edition of Bell's book becomes one of the best general references of its kind. Because of the breadth of the subject matter covered, the text on any one topic is necessarily brief and elementary. Some petroleum development engineers, for instance, may at first be surprised that all the alkylation, isomerization and dehydrogenation processes of which they have rightly been so proud occupy only 14 pages as compared to the two chapters devoted to the more basic processes of dewaxing.

The first few chapters deal with the physical and chemical properties of crude oils and their individual hydrocarbons. A very brief section discusses the problems involved in selecting a refinery and in determining the plant layout. Then, considerable space is given to the basic principles, design and operating problems involved in distillation, heat transfer and fractionation, after which, with logic, shell stills, pipe heaters, condensers and heat exchangers, and distillation units are discussed.

Other than a rather brief discussion of processes for making gasoline and a more lengthy section on treatment and dewaxing, the remaining half of the book is devoted to such topics as refrigeration, filtering, packaging and storage, fire protection, volume measurements, evaporation losses, pumping, bulk transportation, and boiler houses. One chapter deals with such "general" departments as the machine shop, waste disposal unit and docks. It is good to see such topics discussed, for they are too often neglected.

Well illustrated with photographic reproductions, flow diagrams, drawings and charts, this book contains as much information as any one-volume, non-encyclopedic reference that takes an entire industry, and a very complex one, as its domain.

METALLURGISTS' VADE MECUM

Handbook of Nonferrous Metallurgy. *Second edition. Edited by Donald M. Liddell. McGraw-Hill Book Co., New York. 1,377 pages. $13.50.*

Reviewed by E. C. Fetter

Since the first edition of Liddell's nonferrous handbook appeared in 1926 it has come to be recognized as a standard item on the metallurgical bookshelf, both as text and as reference work. However, for the benefit of those to whom it may not be familiar, it should be explained that the handbook consists of two volumes, the first ("Principles and Processes," 656 pp. $6.50.) treating "common denominator" materials and operations (crushing, classification, fuels, pyrometry and the like), while the second ("Recovery of the Metals," 721 pp. $7.) deals with the metallurgy of the individual non-ferrous metals. Each chapter is written by a specialist. Its scope is confined to production metallurgy and in general it does not go into processing of the metals beyond the point where they have been won from

RECENT BOOKS RECEIVED

Electronics for Engineers. By J. Markus & V. Zeluff. McGraw-Hill. $6.

Electron Optics and the Electron Microscope. By V. K. Zworykin, G. A. Morton, E. G. Ramberg, J. Hillier & A. W. Vance. Wiley. $10.

Glycerin, Its Industrial and Commercial Applications. By G. Leffingwell & M. Lesser. Chemical. $5.

International Cartels. By E. Hexner. University of North Carolina. $6.

Our Oil Resources. Ed. by L. M. Fanning. McGraw-Hill. $4.

Surface Active Agents. By C. B. F. Young & K. N. Coons. Chemical. $6.

Symposium on Stress-Corrosion Cracking of Metals. ASTM & AIME. $7.50.

their ores. Incidentally, it is in this field that metallurgical and chemical engineering have most in common.

As to the nature of the revising done in preparing the second edition, it appears that for the most part a straight modernization job has been performed of the old text. Except that "metallography" has been dropped and "drying," "flotation," "filtration," and "beryllium" have been added, the 43 chapter headings are in substance without change. New paragraphs and sections have been inserted to handle recent developments and some obviously obsolete material has been deleted.

It is undoubtedly true, as stated in the preface, that the authors were prevented by security restrictions from including much that was known to them. That being the case, it is the reviewer's opinion that revision might better have been postponed a few more years, when the authors would have had more freedom of expression, and we might guess, more time.

GOVERNMENT PUBLICATIONS

The following recently issued publications are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publication noted in this list always give the complete title and the issuing office. Remittances should be made by postal money order, coupon, or check. Do not send postage stamps. All publications are in paper covers unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the bureau responsible for its issue.

Effect of Variables in Chemical Beneficiation of Chromite Ores. By F. S. Boericke and W. M. Bangert. Bureau of Mines, Report of Investigations R. I. 3817. Mimeographed.

Electrolytic Manganese in Acid-Steel Tests at Atlas Steel Casting Co. and The Detroit Steel Casting Co. By R. T. C. Rasmussen. Bureau of Mines, Report of Investigations R. I. 3830. Mimeographed.

Stench Warning Tests Lake Superior District Mines. By F. E. Cash and Ernest W. Johnson. Bureau of Mines, Report of Investigations R. I. 3850. Mimeographed.

The Sterling Area (A Study of Monetary and Exchange Policy). By Donald F. Heatherington. Bureau of Foreign and Domestic Commerce. Price 5 cents.

Quicksilver-Antimony Deposits of Huitzuco, Guerrero, Mexico. Geological Survey Bulletin 946-B. Price 60 cents.

Japanese Trade Studies: Annotated Tabular Survey of the Trade of Japan Proper (Including That With Korea and Formosa). U. S. Tariff Commission. Unnumbered processed.

Japanese Trade Studies: Raw Silk: U. S. Tariff Commission. Special Industry Analysis No. 10. Mimeographed.

Method of Handling Hydrogen Sulfide Gas in the Elk Basin Oil Field of Wyoming. By J. H. East, Jr. and Ralph H. Espach. Bureau of Mines, Information Circular I. C. 7334. Mimeographed.

Manual of Fire-Loss Prevention of Federal Fire Council. (Supercedes National Bureau of Standards Handbook H 19.) Public Buildings Administration. Unnumbered. Price 30 cents.

Health-Benefit Programs Established Through Collective Bargaining. Bureau of Labor Statistics, Bulletin No. 841. Price 10 cents.

Surface Water Temperatures, Pacific Coast.

U. S. Coast and Geodetic Survey, Department of Commerce. Unnumbered processed.

Record Keeping for Small Stores. Revised. Senate Committee Print No. 2, 79th Congress. Price 35 cents.

Government-Owned Pipe Lines. Report of the Surplus Property Administration to the Congress, January 4, 1946. Unnumbered printed. Price 20 cents.

Rotenone (Synopsis of Information). By L. N. Markwood and Laura G. Arrington. Bureau of Foreign and Domestic Commerce. Price 5 cents.

A Study of Certain Factors in the Hydrometallurgy and Electrodeposition of Cobalt. By F. K. Shelton, R. E. Churchward, J. C. Stahl, and G. F. Livingston. Bureau of Mines, Report of Investigations R. I. 3832. Mimeographed.

A Third List of Publications on DDT. January Through June 1945. By R. C. Roark. Bureau of Entomology and Plant Quarantine E-674. Mimeographed.

Summary of DDT Experiments on Insects that Affect Man and Animals. By W. E. Dove. Bureau of Entomology and Plant Quarantine E-673. Mimeographed.

Consumption of Industrial Explosives in 1944. Bureau of Mines. Supplement to Mineral Market Report No. MMS 1283. Processed.

Some Soil Properties Related to the Sodium Salt Problem in Irrigated Soils. By Robert Gardner. Bureau of Plant Industry. Department of Agriculture Technical Bulletin No. 902. Price 10 cents.

Credit Sources for Small Business. Department of Commerce. Price 15 cents.

Federal Specifications. New or revised specifications which make up Federal Standard Stock Catalog have been issued on the following items: Trichloroethylene; Technical - Grade O-T-634. Barrels; Wood, Slack NN-B-109. Kegs; Wood, Slack NN-K-231. Price 5 cents each.

RECENT BOOKS and PAMPHLETS

Manual Sheet TC-2. Published by Manufacturing Chemists' Association, 608 Woodward Bldg., Washington, D. C. 6 pages; 12 cents. Cars, Tank—Steel, I.C.C. Spec. 103B, Rubber-Lined, Unloading, When Filled With Muriatic Acid or Other Liquids Authorized for Shipment Therein.

Shop Terms. Published by Syracuse University Press, Syracuse, N. Y. 120 pages; $1. Reference manual for industrial workers.

Symposium on Magnetic Particle Testing. Published by American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Pa. 122 pages; $1.25. Eight papers presented at a meeting of the Philadelphia District, ASTM, January 1945.

Grain Sizes Produced by Recrystallization and Coalescence in Cold-Rolled Cartridge Brass. By H. L. Walker. Bulletin 359, published by Engineering Experiment Station, University of Illinois, Urbana. 55 pages. Price 75 cents. Grain size at complete recrystallization is a function of prior cold deformation and may be expressed by an equation.

Aluminum Plants and Facilities. Available from Superintendent of Documents, Washington 25, D. C. 131 pages. Price 25 cents. Report of the Surplus Property Board to the Congress, September 21, 1945.

Magnesium Plants and Facilities. 48 pages. Report of the Surplus Property Administration to the Congress, December 7, 1945.

Technology Department of the Carnegie Library of Pittsburgh. Published by the library, 4400 Forbes St., Schenley Park. 15 pages. Facilities and services offered by the library.

Oregon Bauxite. By F. W. Libbey, W. D. Lowry and R. S. Mason. Published by Oregon Dept. of Geology and Mineral Industries, 702 Woodlark Bldg., Portland, Ore. 97 pages; $1. A publication describing the geology, location and economics of the state's feruginous bauxite deposits.

Toxicity of Herbicides to Livestock. By R. N. Raynor and J. W. Britton. Published by University of California, College of Agriculture, Berkeley 4, Calif. 5 pages. Information as to effects of various herbicides upon animals. Includes data on fatal dosages, precautions, symptoms and treatment.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterheads.

Adhesives. National Adhesives, Div. of National Starch Products, Inc., 270 Madison Ave., New York, N. Y.—Handbook on glued loads which illustrate and describe procedures for palletizing and for utilizing shipments of packed goods with "Load-Lok" adhesives.

Alcohols. Carbide and Carbon Chemicals Corp., 30 E. 42nd St., New York 17, N. Y.—28-page booklet containing complete information on fifteen synthetic alcohols produced by this company. Lists properties, specifications, shipping data and other information about the uses of alcohols.

Alloy Welding. Arcos Corp., 1515 Locust St., Philadelphia 2, Pa.—A reference chart on high and low alloy welding electrodes which includes tables on corrosion resistance and on weld metal surfacing is now available from this company.

Aluminum Research. Aluminium Fiduciaries Limited, Dominion Square East, Montreal, Canada—Illustrated brochure describing the Kingston Research Laboratory of the Aluminium Laboratories Limited. Description of the research facilities is given.

Boilers. Union Iron Works, Erie, Pa.—Booklet 118. 20-page booklet illustrating and describing the various types of steam boilers manufactured by this company. Typical applications are illustrated; a section of the book is devoted to the manufacturing facilities of this company.

Brushes. Milwaukee Dustless Brush Co., 530 N. 22nd St., Milwaukee 3, Wis.—8-page folder illustrating the floor brushes manufactured by this company.

Cast Iron Pipe. American Cast-Iron Pipe Company, Birmingham 2, Ala.—20-page brochure featuring the testing and research facilities of this company.

Catalytic Cracking. American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York 20, N. Y.—20-page booklet featuring catalytic cracking operations using Aerocat cracking catalysts. A table of pilot plant data comparing synthetic and natural catalysts is included.

Cellulose Finishes. Dexter Chemical Corp., 819 Edgewater Rd., New York, 59, N. Y.—Four-page reprint entitled New Developments in Permanent Cellulose Finishes.

Chemicals. Sharples Chemicals, Inc., Philadelphia, Pa.—Four-page leaflet announcing price reductions on Sharples ethylamines. Specifications, together with present and suggested uses for these products, are given.

Chlorinated Lime. Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia 7, Pa.—A new booklet describing Quaker improved chlorinated lime used in water sterilization and for the bleaching of textiles, pulp, paper and cotton.

Compressors. Clark Bros. Co., Inc., Olean, N. Y.—12-page reprint entitled Modern Compressor Station Design illustrates and describes compressor installations used in the handling of natural gas.

Condensate System. Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia 32, Pa.—Publication No. 3250. This booklet describes in detail the high-pressure condensate return system used in installations involving steam pressures up to 250 lb. per sq. in.

Conveyors. Robins Conveyors, Inc., Passaic, N. J.—Bulletin No. 127. 16-page booklet illustrating and describing the mine conveyors available from this company. Detail drawings of the different types of installations are given and the features of these conveyors are discussed.

Corrosion Inhibitors. Mutual Chemical Co. of America, 270 Madison Avenue, New York, N. Y.—Serial No. 333. 16-page technical bulletin entitled Chromate Corrosion Inhibitors for Internal

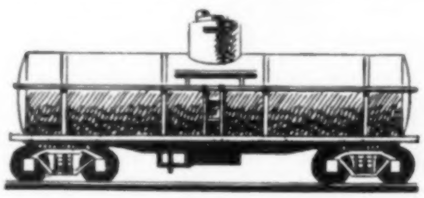
SHIPPED

WHERE and HOW

YOU WANT IT

V-C
75%
Phosphoric
Acid

An acid of high purity
and wide utility



TANK CAR
CARBOYS
BARRELS

Carloads or less carload lots

We are constantly improving our production facilities in our effort to meet the increasing demands of industry for V-C Phosphoric Acid. Whether you need a carboy or a tank car, your inquiry will receive our full attention.

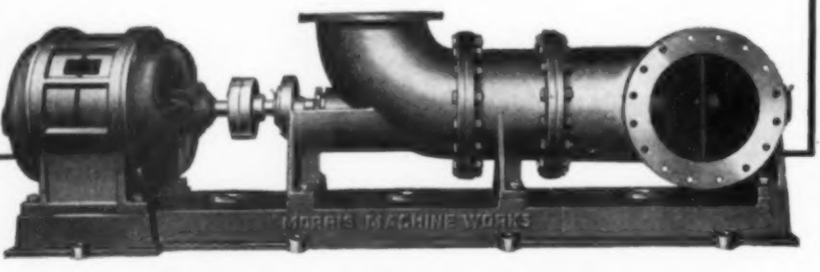
V-C H_3PO_4 85% U.S.P. Syrupy
V-C H_3PO_4 85% Technical Grade
V-C H_3PO_4 75% Food Grade

VIRGINIA-CAROLINA CHEMICAL CORPORATION

RICHMOND 5, VIRGINIA

VC CHEMICALS

HAND IN HAND WITH INDUSTRY



Combustion Systems. Materials used to protect the cooling systems of various types of engines are discussed. Also 12-page reprint entitled Chromate Corrosion inhibitors in Bimetallic Systems reports on test data on this subject.

Corrosion-Proof Masonry. U. S. Stoneware Co., Akron 9, Ohio—52-page booklet entitled Corrosion-Resistant Masonry Material and Construction Manual featuring the products of this company. Specifications and properties of the cement and brick shapes furnished are included. The resistance of certain of these materials to a wide variety of chemicals and chemical materials is shown. A section of the booklet is devoted to the construction of masonry equipment. Several pages are devoted to tables and engineering data.

Detergents. Alrose Chemical Co., 180 Mill St., Cranston, R. I.—12-page technical bulletin featuring Alrosol, a wetting-agent and detergent manufactured by this company. Properties and uses of this material are given.

Electric Motors. Electric Machinery Manufacturing Co., Minneapolis 13, Minn.—4-page folder illustrating and describing the economies and operating advantages gained by the use of synchronous motors. Publication No. FF-11

Fire Brick. The Ironton Fire Brick Co., Ironton, Ohio.—4-page leaflet featuring the various refractories manufactured by this company.

Furnaces. Hevi-Duty Electric Co., Milwaukee 1, Wis.—Bulletin HD-1245. 12-page booklet featuring the special pit type induction furnaces manufactured by this company. Features of the furnaces together with construction, operation, and application data are discussed and specifications are given.

Gears. Abart Gear & Machine Co., 4832 W. 16th St., Chicago 50, Ill.—4-page leaflet describing the various gears and speed reducers manufactured by this company.

Heaters. Whitlock Manufacturing Co., Hartford 1, Conn.—Bulletin No. 25. 12-page booklet illustrating and describing the Whitlock fuel oil heaters. Dimensions and rating capacities of the various types of heaters are included.

Heat Treating. Lukens Steel Co., 281 Lukens Bldg., Coatsville, Pa.—Three leaflets describing heat treating services offered by this company.

Hortonspheres. Chicago Bridge & Iron Co., 332 So. Michigan Ave., Chicago 4, Ill.—Bulletin F. 8-page folder discussing the design, principle of operation, maintenance and operation together with other valuable information on Hortonspheres. A table of standard capacities for these storage tanks is included.

Instruments. Combustion Control Corp., 77 Broadway, Cambridge 42, Mass.—Bulletin 103C. 4-page folder illustrating and describing the Fireye bolier feedwater control system furnished by this company. Bulletin 102C. 4-page folder illustrating and describing the Fireye photoelectric flame-failure safeguard for oil and pulverized coal burners. Specifications and dimensions are given.

Instruments. Fischer & Porter Co., Hatboro, Pa. Bulletin 45-A. An 8-page bulletin featuring this company's rotameters and accessory equipment. Included are two pages of engineering recommmendations for the types of rotameters and materials of construction for use in measuring the flow rates of a large number of corrosive fluids and gases. Tables giving sizes and capacities are shown.

Instruments. Foxboro Instrument Co., Foxboro, Mass.—Catalog 370. This company's full line of recording and indicating instruments for measurement and control are illustrated and described in a new catalog recently published by this company. Various sections deal with different types of instrument applications and the methods of control used.

Instruments. H-B Instrument Co., 2519 N. Broad St., Philadelphia 32, Pa.—6-page illustrated catalog describing in detail the complete line of temperature control instruments manfactured by this company.

Instruments. Marion Electric Instrument Co., Manchester, N. H.—28-page booklet illustrates and describes the line of standard and electric indicating instruments manufactured by this company.

Instruments. Moore Products Co., H & Lycoming Streets, Philadelphia 24, Pa.—Bulletins 401 and 402. Leaflets illustrating and describing the Moore Nullmatic remote manual control system. Specifications and performance data are given and the Nullmatic pressure regulator is illustrated in detail.

Instruments. Taylor Instrument Cos., Rochester, N. Y.—8-page bulletin illustrating and describing this company's level-buoy indicating controller. Construction features, operating character-

istics, and application data are discussed and illustrated. Bulletin 91861.

Insulating Cement. Baldwin-Hill Co., Trenton, N. J.—4-page illustrated folder featuring B-H No. 1 insulating cement manufactured by this company.

Ion Exchangers. Chemical Process Co., 58 Sutter St., San Francisco 4, Calif. Bulletin 1135. 32-page illustrated booklet discussing the properties and uses of "Duolites," this firm's line of synthetic resin ion exchangers. Contains tabulated engineering data on flow rates, stability, washing characteristics and regeneration. Discusses industrial applications.

Magnesium Metals. White Metal Rolling and Stamping Corp., 80 Moultrie St., Brooklyn 22, N. Y.—8-page booklet featuring the magnesium metal alloys manufactured by this company. Contains specifications, physical properties and commercial tolerances, together with other useful data on these products. A discussion of the methods used in welding, forming, bending and drawing of magnesium and its alloys, and the corrosion resistance of this material is included.

Magnets. The Richmond Mfg. Co., Lockport, N. Y.—4-page folder featuring the Niagara Permaflux magnet for separating ferrous impurities from non-ferrous powdered, granular or flaked products. Dimensions and installation data are included.

Marking Equipment. Acme Marking Equipment Co., 2222 W. Fort St., Detroit 16, Mich.—32-page catalog featuring marking equipment such as steel stamps, type holders, branding irons, name plates, etc.

Microcastings. Austenal Laboratories, Inc., 224 E. 39th St., New York, N. Y.—8-page illustrated booklet describing the microcast process for making castings of different shapes and design from high melting point, non-machineable alloys. A pictorial step-by-step picture of this process is shown.

Nickel Alloys. International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.—8-page leaflet listing current publications on nickel alloys, nickel cast irons, nickel brass and bronzes, and nickel plating is now available from this company.

Organic Halides. Halogen Chemicals, 616 King St., Columbia 62, S. C.—8-page price list covering the prices of calcium chlorides and bromides, fluorochlorides, chloroolefins, polychlorides and other chemicals manufactured by this company.

Pest Control. Hercules Powder Co., Wilmington, Del.—Pocket-size folder illustrating and featuring DDT concentrates supplied by this company.

Plastics. Bakelite Corp., 30 E. 42nd St., New York 17, N. Y.—36-page booklet entitled "Selecting the Right Thermosetting Molding Material." Includes data on how to select molding plastics together with detailed discussion of the properties of thermosetting molding materials.

Welded Fabrication. United Welding Co., Middletown, Ohio—20-page brochure illustrating and describing the technique employed in fabricating equipment by welding processes. Includes a section on the factors affecting the choice of welded fabrication as well as a section on actual detailed technique of welding design. Contains a page describing welding symbols used in this work.

Welding. Haynes-Stellite Co., 30 E. 42nd St., New York, N. Y.—4-page illustrated folder describing Hastelloy facing for corrosion resistance. Includes data on the grades of Hastelloy available and the corrosive media they will resist, together with a list of parts that can be Hastelloy faced.

Wetting Agent. Rumford Chemical Works, Rumford 16, R. I.—Bulletin 140. Pocket size folder featuring Quadrafos, an anhydrous sodium tetraphosphate manufactured in granular and bead form by this company. This folder describes how to use this material in the various operations for processing woolens, cottons, rayons, linens and silks.

Wire Rope Clamp. Nunn Manufacturing Co., 2125 Dewey Ave., Evanston, Ill.—Illustrated leaflets featuring the Cabl-ox wire rope clamp manufactured by this company. Sizes and prices are included.

Wood Tanks. Acme Tank Manufacturing Co., 5402 South Soto St., Los Angeles 11, Calif.—Bulletin B-45 IML. 23-page booklet giving diagrams, photographs and specifications for tanks, tank foundations, fittings and covers. Gives directions for erecting special types of tanks.

Wood Tanks. Santa Fe Tank & Tower Co., 4820 Santa Fe Ave., Los Angeles 11, Calif. Booklet entitled "Wood Tanks for the Petroleum Industry" which gives engineering data on wood tanks for storage of corrosives and for fire protection.

CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

INTERRUPTIONS IN OPERATATING SCHEDULES CURTAIL PRODUCTION AND CONSUMPTION OF CHEMICALS

Although work stoppages on a large scale have been in industries outside of chemical manufacture, the effects of such curtailments in production have been widespread enough to extend to several branches of the chemical industry and to many lines which are consumers of chemical products. The most immediate reaction to the closing of steel plants was found in a sharp drop in the output of crude coal-tar and in coal-tar crudes. To a lesser extent, but one that could become progressively important, was the threat of a stoppage of shipments of coal-tar crudes to plants which convert them into dyes, pharmaceuticals, and finished chemicals. The practical elimination of sulphate of ammonia production at byproduct coke plants automatically cut down the supply for the fertilizer trade at a time when mixers were operating actively.

The chemical industry in the latter half of January and the early part of February was further adversely affected by delays in deliveries of materials required for carrying out expansion programs and by difficulties in shipping chemicals due to the shortage of steel drums. The substitution of wooden containers became more widespread, even caustic soda having been shipped in barrels. Despite all unfavorable conditions, demand for chemicals has remained relatively active but the degree of activity has been lowered because some of the large consuming lines have been forced to curtail operations either because of labor troubles within their own ranks or because of outside interference with the flow of raw materials to their plants or the movement of finished products from their plants.

From the incomplete data at hand it is evident that there was a mixed trend in manufacturing lines throughout January, some of this arising after the closing of steel mills and some of it depending upon conditions in the separate branches of industry. Oil refining continued along a plane very much in line with that reported for December. Paper mills which had cut operating rates sharply in the closing week of last year, opened the new year at a good rate and went through the month at a pace considerably above that maintained in January 1945. Glass plants likewise made an improved showing with plate and window glass plants getting into full production after some of them had been closed for weeks due to a strike of workers. The outlook for glass containers has been improved by the time lost at steel mills as this further puts off the time when can makers will be able to operate at capacity.

According to the Federal Reserve Board, production of chemicals wound up last year on a rising trend. The index of the Board showed a drop in all production from 167 in November to 162 in December, but for chemicals the index was 233 for December as against 230 for November and for industrial chemicals the index rose from 369 in November to 373 in December. Actual production data for December bear out the movement of the indexes as higher outputs were reported for such important chemicals as sulphuric acid, soda ash, caustic soda, chlorine, and trisodium phosphate. Trisodium phosphate has been in limited supply for a long time and while record outputs have been attained in the last three months the supply still is inadequate to meet demands. The increase in caustic soda production is in accord with the statistical position of the market and it is noted that while chlorine is in ample supply the rise in caustic output came more from electrolytic than from lime-soda plants.

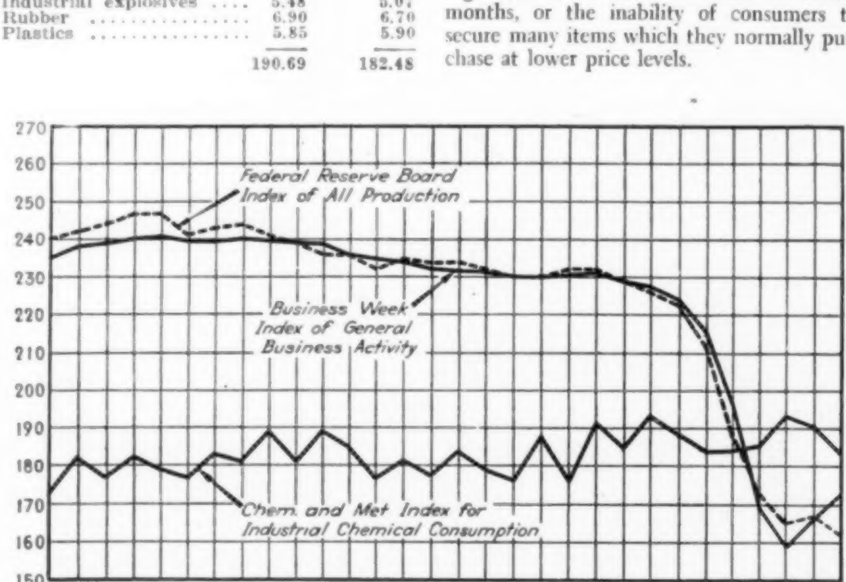
Contrary to the upward swing in chemical production in December, the *Chem. & Met.* index for industrial consumption of chemicals dropped sharply in that month with at least a part of the decline attributed to a longer-than-usual observance of the holiday season. The index for December is 182.48 which compares with 190.69 for November. With the exception of petroleum refining and steel plants which had speeded up operations slightly, the decline was fairly general throughout the various consuming industries with the probability that daily rates had been at least up to those of the month preceding.

Chem. & Met. Index for Industrial Consumption of Chemicals
1935 = 100

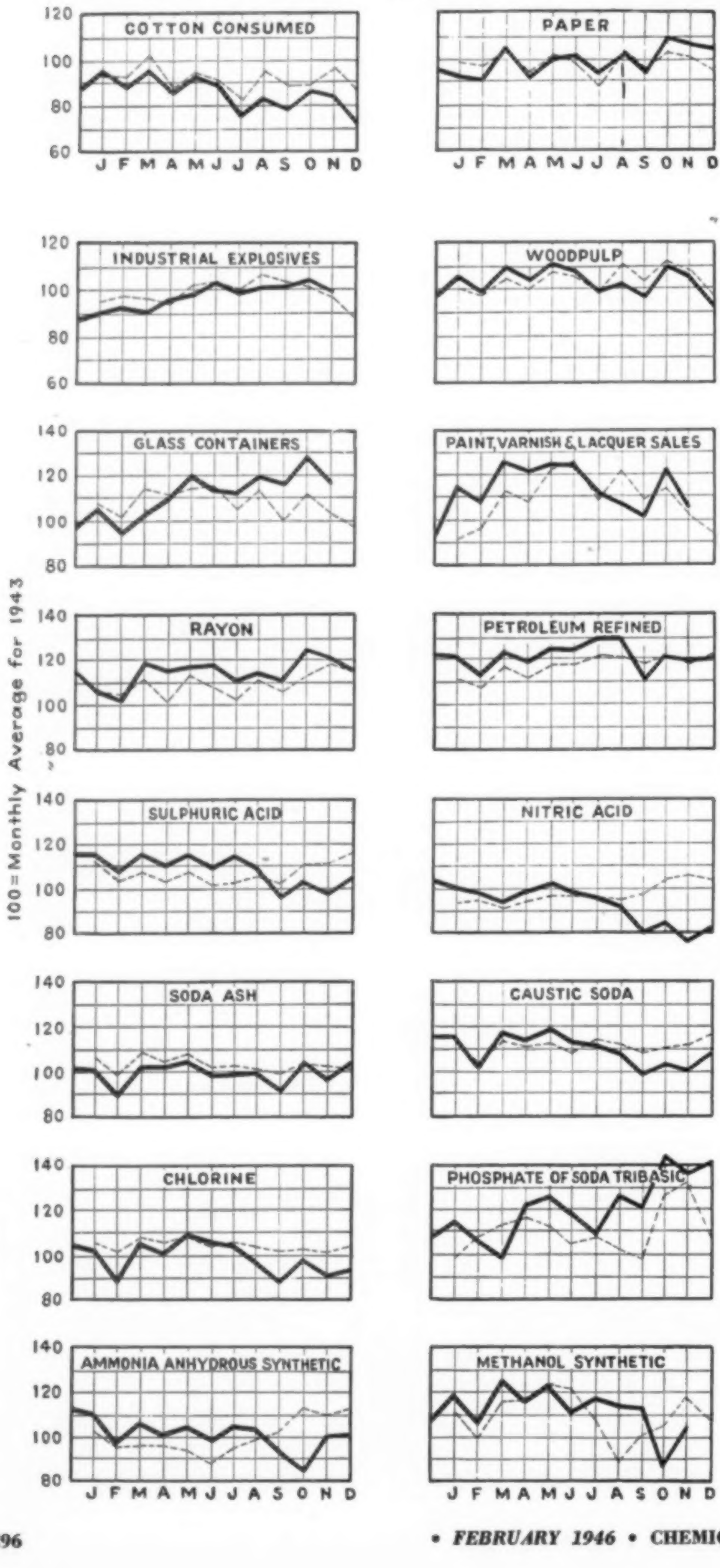
	Nov.	Dec.
Fertilizers	45.15	39.98
Pulp and paper	20.10	19.70
Petroleum refining	18.47	18.62
Glass	19.62	19.30
Paint and varnish	16.32	15.80
Iron and steel	10.96	11.11
Rayon	19.05	18.68
Textiles	10.19	9.27
Coal products	7.95	7.80
Leather	4.65	4.55
Industrial explosives	5.48	5.07
Rubber	6.90	6.70
Plastics	5.85	5.90
	190.69	182.48

General business, particularly the retail branches, made an exceptional showing in December and January. In view of the reserve purchasing power it had been expected that the holiday season would establish a new dollar volume of business but the showing in January was more than anticipated and it is significant because it indicates that so long as consumer confidence is not lowered there will be an active demand for a varied line of consumer products which in turn means a corresponding call will be felt for the varied line of chemicals and other raw materials that are used in making these finished products. This is merely further evidence of earlier views that pent-up consumer demand together with high purchasing power would be important in maintaining a high rate of manufacturing production.

The Department of Commerce recently pointed out that the outstanding feature of the business situation at the end of the year was the substantial rise in consumer buying. The flow of sales through retail channels was unhampered either by the declining trend of workers' incomes in recent months, or the inability of consumers to secure many items which they normally purchase at lower price levels.



PRODUCTION AND CONSUMPTION TRENDS



MANUFACTURING industry has advanced so far this year in a period of reconversion—if we may apply that term to the settlement of all problems which stand in the way of putting production on a full peacetime capacity. Some time ago estimates were made regarding the probable position of producing industries after reconversion had been completed. Here the word reconversion carried the meaning of a change about in plant equipment and formulas which would adapt them to the production of civilian rather than war goods.

Where production has been free to go ahead without labor troubles or other outside restrictive influences there has been ample evidence that conditions are ripe for a level of production and consumption which will not compare too unfavorably with the peaks of the war years. However as this inclusive reconversion has advanced it has found that difficulties have arisen which were not foreseen. These go beyond the wide areas of work stoppages and higher production costs.

As a case in point reference is made to pulp and paper manufacture which held up well throughout the war years and for which greatly expanded markets are predicted for the immediate peacetime period. Current rate of output is relatively high but it has been estimated that plant capacities and consumer demand warrant an annual increase in paper output of 1,000,000 tons. In theory the prospects of a fully adequate supply of pulp are favorable, domestic pulp production being helped by a return to the woods of workers released from the armed forces and from war plants. The return of normal shipping conditions makes it possible to expand the volume of imports which amounted to about 600,000 tons in the latter half of last year. Actually these favorable aspects are more prospective than real. There has been no heavy influx of workers to get out the timber. Wood cutters are demanding an upward revision in their wage scales before returning to work and until some settlement has been effected, domestic woodpulp production will not come up to expectations. A similar turn has entered into negotiations for foreign pulp. Swedish exporters have asked for a higher ceiling for their offerings.

In the pigment field, corroders of lead already have had their allotment reduced because of scarcity of the metal and recent advices are to the effect that industrial users will be forced to take a further cut in the near future with the prospects that the supply situation will get worse as the year progresses. While the shortage of white lead may be lessened somewhat through wider use of other pigments the over-all supply does not look promising. While some high-cost producers were in operation during the war period, total lead production was far from record levels. Contributing most to the declining trend in lead output has been the fact that ore reserves have been dwindling. The essentials for near-future improvement in production are higher prices for the product and the ability to recruit a larger number of workers at mines.

United States Production of Certain Chemicals

November 1945, November 1944 and Eleven-Month Totals for 1945 and 1944

Chemical and Basis	Units	November 1945	November 1944	Eleven-Month Totals 1945	Eleven-Month Totals 1944
Ammonia, synthetic anhydrous[1]	Tons	45,298	49,721	504,198	492,565
Ammonium nitrate (100% NH_4NO_3)	Tons	39,678	......	....	....
Ammonium sulphate, synthetic (technical)	M lb.	16,015	......	....	....
Calcium arsenate (100% $Ca_3(AsO_4)_2$)	M lb.	1,403	2,038	25,644	42,957
Calcium carbide (commercial)	Tons	44,610	65,806	628,707	717,502
Calcium phosphate:					
Monobasic (100% $CaH_4(PO_4)_2$)	M lb.	6,793	5,949	57,550	55,555
Dibasic (100% $CaHPO_4$)	M lb.	7,518	3,910	50,768	45,668
Carbon dioxide:					
Liquid and gas	M lb.	16,554	21,657	196,986	291,388
Solid (dry ice)	M lb.	42,856	48,409	624,536	603,540
Chlorine	Tons	91,453	101,999	1,097,289	1,155,161
Chrome green (C.P.)	M lb.	1,493	690	7,421	5,927
Chrome yellow and orange (C.P.)	M lb.	4,773	2,984	39,637	31,230
Copper acetoarsenite (Paris green)	M lb.	289[7]	374[7]	3,586[7]	3,657[7]
Hydrochloric acid (100% HCl)	Tons	30,026	35,106	378,561	343,927
Hydrofluoric acid	M lb.	3,834	......	....	....
Hydrogen	M cu. ft.	1,399,000	2,114,000	20,755,000	22,241,000
Lead arsenate (acid and basic)	M lb.	4,253	7,528	65,478	81,879
Molybdate chrome orange (C.P.)	M lb.	353	112	1,897	1,235
Nitric acid (100% HNO_3)	Tons	31,348	42,571	414,045	430,007
Oxygen	M cu. ft.	875,350	1,529,856	13,035,460	17,246,268
Phosphoric acid (50% H_3PO_4)	Tons	70,409	54,626	649,628	633,590
Soda ash (commercial sodium carbonate):					
Ammonia soda process (98-100% Na_2CO_3):					
Total wet and dry[2]	Tons	355,039	374,453	3,995,231	4,169,910
Finished light[3]	Tons	177,737	197,154	2,088,044	2,258,053
Finished dense	Tons	123,237	124,415	1,315,379	1,337,813
Natural[4]	Tons	15,283	14,752	167,146	164,908
Sodium bicarbonate (refined) (100% $NaHCO_3$)	Tons	15,692	12,840	158,135	144,800
Sodium bichromate and chromate	Tons	7,001	6,866	73,905	75,123
Sodium hydroxide (100% NaOH)[5]:					
Electrolytic process:					
Liquid	Tons	85,616	99,428	1,038,957	1,101,331
Solid	Tons	16,073	......	196,900	....
Lime-soda process:					
Liquid	Tons	62,516	59,314	671,891	626,211
Solid	Tons	20,340	......	223,521	....
Sodium phosphate:					
Monobasic (100% NaH_2PO_4)	Tons	1,307	2,406	13,603	15,753
Dibasic (100% Na_2HPO_4)	Tons	5,528	5,292	55,160	51,853
Tribasic (100% Na_3PO_4)	Tons	8,299	7,930	80,021	73,707
Meta (100% $NaPO_3$)	Tons	2,740	2,284	25,396	23,842
Tetra (100% $Na_4P_2O_7$)	Tons	4,104	3,431	39,179	36,112
Sodium silicate (anhydrous)	Tons	28,843	39,387	381,455	387,452
Sodium sulphate:					
Anhydrous (refined) (100% Na_2SO_4)	Tons	9,530	6,022	75,996	69,906
Glauber's salt and crude salt cake[4]	Tons	67,099	68,109	695,339	732,106
Sulphuric acid:[4]					
Chamber process (100% H_2SO_4)	Tons	255,215	279,515	2,906,831	2,947,139
Net contact process (100% H_2SO_4)[6]	Tons	402,363	467,447	5,099,970	4,828,353
Zinc yellow (zinc chromate) (C.P.)	Tons	197	......	13,296	....

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census and WPB Chemicals Bureau. Production figures represent primary production and do not include purchased or transferred material. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given, data are either confidential or not yet available. [1]Includes a small amount of aqua ammonia. [2]Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate and quantities processed to finished light and finished dense. [3]Not including quantities converted to finished dense. [4]Data collected in cooperation with the Bureau of Mines. [5]Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6]Includes oleum grades. Excludes spent acid. [7]Figures given are for Oct. and totals are for ten months production.

United States Production Of Certain Synthetic Organic Chemicals

October 1945, October 1944 and Ten-month Totals for 1945 and 1944

Chemical	October 1945	October 1944	Total, First Ten Months 1945	Total, First Ten Months 1944
Acetanilid, technical and U.S.P.	643,965	....	4,770,593	....
Acetic acid:				
Synthetic[1]	19,134,418	23,856,623	221,124,934	240,800,467
Recovered	58,589,725	....	....	....
Natural[2]	2,235,000	3,715,813	28,050,671	33,703,894
Acetic anhydride[3]	38,534,998	42,084,200	435,720,436	407,427,908
Acetone	17,321,940	....	....	....
Aniline	6,468,661	....	....	....

(*Continued on page 300*)

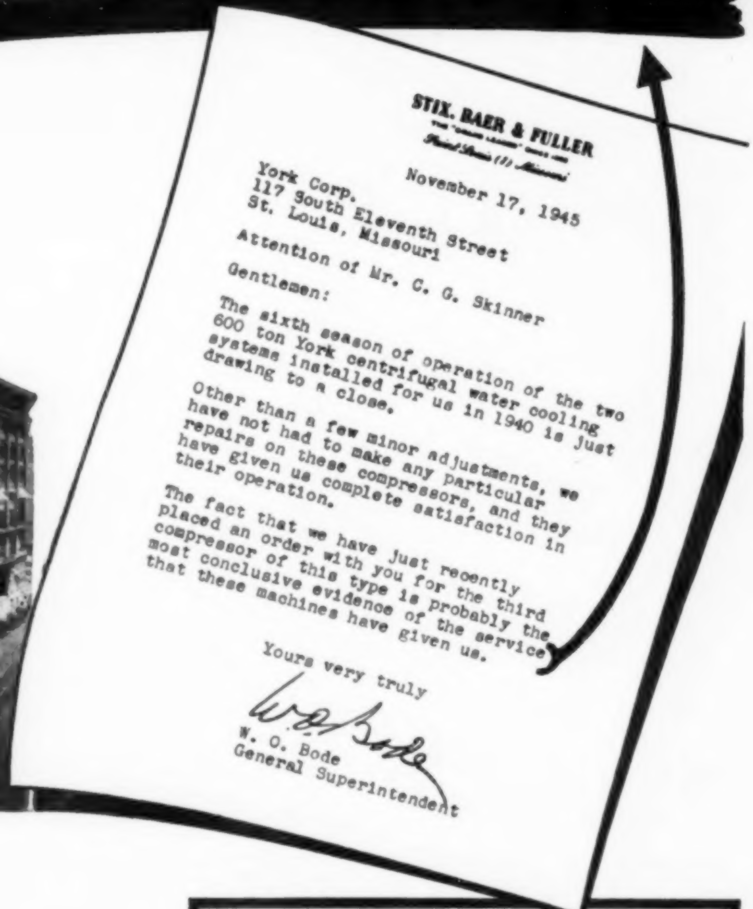

THE A-B-C's OF TROUBLE-FREE VALVE PERFORMANC
A
Use the right type of valve for the service...
Select the metal, pattern, and type of seat best suited to the particular service . . . Get advice from us or your Jenkins Distributor.
B
Place valves correctly in the line...
Where and how valves are installed makes a difference in their efficiency and service life . . . Write for booklet No. 944 on installation.
C
Choose Jenkins Valves for lifetime economy!
EXAMPLE: Fig. 950 GLOBE
THESE BRONZE GLOBE valves are especially recommended for the control of up to 200 lbs. steam at 550° F.; up to 400 lbs. non-shock cold oil, water, gas, where service conditions are severe, tightness is essential and operation is frequent. Easy to dismantle and reassemble, easy to regrind without removal from the line. Insertion of handy regrinding pin enables spindle to serve as grinding tool. Face of seat ring parallels and equals that of disc, assuring constant contact area, tight closure, prevention of shoulder or grooves in regrinding. Disc and seat ring renewable.
As in all Jenkins Valves, better design, better materials, better workmanship, insure lifetime economy in long, trouble-free service and minimum maintenance costs.
Jenkins Bros., 80 White Street, New York 13; Bridgeport; Atlanta; Boston; Philadelphia; Chicago; San Francisco. Jenkins Bros., Ltd., Montreal; London.
PERFECT-GRIP HANDWHEEL
SECURE WHEEL NUT
HIGH TENSILE MANGANESE BRONZE SPINDLE
BRONZE GLAND COMPRESSES PACKING
STRONG PACKING NUT
EXTRA DEEP STUFFING BOX
LARGE HEAVY BONNET
HOLE FOR REGRINDING PIN
STURDY UNION BONNET RING
DISC LOCK NUT
NICKEL ALLOY BEVELED DISC
RENEWABLE NICKEL ALLOY SEAT RING
LIBERALLY PROPORTIONED BODY
JENKINS VALVES
TRADE JENKINS MARK
LOOK FOR THIS DIAMOND MARK SINCE 1864
For every service . . . in Bronze, Iron, Cast Steel, Corrosion-Resisting Alloys . . . 125 to 600 lbs. pressure.
Sold Through Industrial Distributors Everywhere

U. S. Production of Synthetic Organic Chemicals (Cont. from p. 298)

Chemica	October 1945	October 1944	Total, First Ten Months 1945	Total, First Ten Months 1944
Acetylsalicylic acid	1,010,833	833,771	8,893,788	7,636,656
Barbituric acid derivatives:[5]				
5-Ethyl-5-phenylbarbituric acid and salts (phenobarbital)	29,747	....	....	....
5-Ethyl-5-(1-methylbutyl)-barbituric acid and salts (pentobarbital)	877	....	....	....
Benzene:				
Motor grade:				
Tar distillers[4]	376,890	....	....	....
Coke-oven operators[6]	4,043,615	....	....	....
All other grades:				
Tar distillers[4]	3,473,047	....	....	....
Coke-oven operators[6]	3,039,605	....	....	....
Butyl alcohol, primary, normal	5,906,393	....	....	....
Carbon bisulphide	23,261,284	....	....	....
Carbon tetrachloride	11,136,450	....	....	....
Chlorobenzene, mono	16,115,518	....	....	....
Creosote oil:				
Tar distillers[4]	10,210,848	10,211,154	106,503,880	100,074,578
Coke-oven operators	3,158,667	3,870,158	30,147,109	34,782,671
Cresols:[7]				
Meta-para	470,027	539,882	6,826,282	5,754,671
Ortho-meta-para	617,702	866,906	7,682,633	8,527,433
Cresylic acid, refined[7]	3,132,956	3,423,706	24,543,386	34,369,215
Dibutyl phthalate	807,719	....	....	....
Dichlorodiphenyltrichloroethane (DDT)	3,037,968	....	....	....
Ethyl acetate (85%)	7,329,352	9,682,672	89,646,171	88,063,812
Ethyl ether, technical and U.S.P.	3,963,871	9,553,380	67,883,603	55,931,032
Formaldehyde (37% by weight)	31,934,286	....	....	....
Methanol:				
Natural[6]	1,487,360	2,154,900	16,376,360	19,661,400
Synthetic	31,358,528	....	....	....
Naphthalene:				
Tar distillers (less than 79 deg. C.)[4]	17,207,846	17,759,552	172,794,470	165,606,637
Tar distillers (79 deg. C. and over)[4]	7,670,410	5,907,481	62,535,772	69,527,578
Coke-oven operators (less than 79 deg. C.)[6]	5,631,640	8,127,569	73,541,707	86,178,979
Penicillin (million Oxford units)[5]	791,636	....	....	....
Phenol (synthetic and natural)[7]	15,565,258	....	....	....
Phthalic anhydride	8,065,675	10,792,415	106,876,091	102,859,294
Styrene (government owned plants only)	21,872,141	....	....	....
Sulfa drugs[5]	460,723	258,172	4,803,318	3,775,741
Toluene:				
Coke-oven operators[6]	1,450,263	....	....	....
All other[4,9]	1,696,004	....	....	....

All data in pounds except benzene (gal.), creosote oil (gal.), toluene (gal.), and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Where no figures are given, data were either unavailable or confidential. [1]Excludes the statistics on recovered acid which are confidential. [2]Acid produced by direct process from wood and from calcium acetate. [3]All acetic anhydride including that from acetic acid by vapor-phase process [4]Product of distillers who use purchased coal tar only. [5]Statistics are given in terms of bulk medicinals only. [6]Statistics collected by Bureau of Mines. [7]Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8]Reported to U. S. Bureau of the Census. [9]Includes toluene from petroleum.

"conclusive evidence of service..."



STIX, BAER & FULLER

November 17, 1945

York Corp.
117 South Eleventh Street
St. Louis, Missouri

Attention of Mr. C. G. Skinner

Gentlemen:

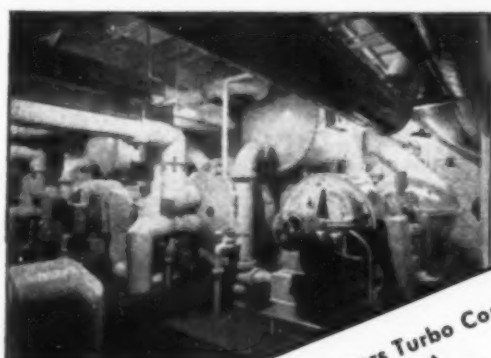
The sixth season of operation of the two 600 ton York centrifugal water cooling systems installed for us in 1940 is just drawing to a close.

Other than a few minor adjustments, we have not had to make any particular repairs on these compressors, and they have given us complete satisfaction in their operation.

The fact that we have just recently placed an order with you for the third compressor of this type is probably the most conclusive evidence of the service that these machines have given us.

Yours very truly

W. O. Bode
General Superintendent



The YORK Allis-Chalmers Turbo Compressors as installed at
STIX, BAER & FULLER CO.
St. Louis, Missouri

OUTSTANDING FEATURES
of the YORK ALLIS-CHALMERS TURBO COMPRESSOR

1. Low center of gravity of compressor—permitted by trough type cooler—cuts vibration, provides accessible operation.

2. Stainless steel impeller blades resist erosion and corrosion assuring perfect wheel balance. Blade rivet heads are eliminated to provide unobstructed gas flow.

3. Balance piston to equalize wheel thrust makes necessary only a positioning thrust bearing, and results in less bearing friction losses.

4. Pre-rotation vanes permit greater capacity reduction (down to 10%).

5. Permanently silver-sealed condenser joints.

6. Simplified refrigerant shaft seal.

York Corporation, York, Pennsylvania.

YORK REFRIGERATION AND AIR CONDITIONING

york refrigeration air conditioning

HEADQUARTERS FOR MECHANICAL COOLING SINCE 1885

CHEM. & MET.

Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

This month	109.13
Last month	109.13
February, 1945	108.84
February, 1944	109.50

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to February 11.

INDUSTRIAL CHEMICALS

Acetone, tanks, lb	$0.06 –	......
Acid, acetic, 28%, bbl., 100 lb	3.38 –	$3.63
Boric, bbl., ton	109.00 –	113.00
Citric, kegs, lb	.20 –	.23
Formic, cbys., lb	.10½–	.11
Hydrofluoric, 30%, drums, lb	.08 –	.085
Lactic, 44% tech., light, bbl., lb	.073–	.075
Muriatic, 18°, tanks, 100 lb	1.05 –	......
Nitric, 36°, carboys, lb	.05 –	.05½
Oleum, tanks, wks., ton	18.50 –	20.00
Oxalic, crystals, bbl., lb	.11¼–	.12½
Phosphoric tech., tanks, lb	.04 –	......
Sulphuric, 60°, tanks, ton	13.00 –	......
Tartaric, powd., bbl., lb	.60 –	.65
Alcohol, amyl	... –	......
From pentane, tanks, lb	.131–	......
Alcohol, butyl, tanks, lb	.10½–	.20
Alcohol, ethyl, denatured, 190 proof		
No. 1 special, tanks, gal	.542	......
Alum, ammonia, lump, lb	.04½–	......
Aluminum sulphate, com. bags 100 lb	1.15 –	1.49
Ammonia, anhydrous, cyl., lb	.14½–	......
tanks, ton	59.00 –	69.00
Ammonium, carbonate, powd., casks, lb	.09¼–	.10
Sulphate, wks, ton	28.20 –	......
Amyl acetate, tech. from pentane, tanks, lb	.145–	......
Aqua ammonia, 26°, drums, lb	.02¼–	.03
tanks, ton	65.00 –	......
Arsenic, white, powd., bbl., lb	.04 –	.04½
Barium carbonate, bbl., ton	65.00 –	75.00
Chloride, bbl., ton	75.00 –	78.00
Nitrate, casks, lb	.09½–	.11
Blanc fix, dry, bags, ton	60.00 –	70.00
Bleaching powder, f.o.b., wks., drums, 100 lb	2.50 –	3.00
Borax, gran, bags, 100 lb	45.00 –	......
Calcium acetate, bags, 100 lb	3.00 –	......
Arsenate, dr. lb	.07½–	.08
Carbide, drums, ton	50.00 –	......
Chloride, flake, bags, del., ton	18.50 –	25.00
Carbon bisulphide, drums, lb	.05 –	.05½
Tetrachloride, drums, gal	.73 –	.80
Chlorine, liquid, tanks, wks., 100 lb.	1.75 –	2.00
Copperas, bgs., f.o.b., wks, ton	17.00 –	18.00
Copper carbonate, bbl., lb	.19½–	.20
Sulphate, bbl., 100 lb	5.00 –	5.50
Cream of Tartar, bbl., lb	.50 –	.52
Diethylene glycol, dr., lb	.14½–	.15½
Epsom salt, dom., tech., bbl., 100 lb.	1.80 –	2.00
Ethyl acetate, tanks, lb	.107–	......
Formaldehyde, 40%, tanks, lb	.032–	......
Furfural, tanks, lb	.09½–	......
Glaubers salt, bags, 100 lb	1.05 –	1.108
Glycerine, c.p., drums, extra, lb	.18¼–	.19
Lead:		
White, basic carbonate, dry, casks, lb	.08¼–	......
Red, dry, sck., lb	.09¼–	......
Lead acetate, white crys., bbl., lb	.12½–	.13
Arsenate, powd., bag, lb	.11½–	.12
Lithopone, bags, lb	.04¼–	.04½
Magnesium carb., tech., bags, lb	.07¼–	.08
Methanol, 95%, tanks, gal	.60 –	......
Synthetic, tanks, gal	.24 –	......
Phosphorus, yellow, cases, lb	.23 –	.25
Potassium bichromate, casks, lb	.10¼–	.10½
Chlorate, pwd., lb	.09¼–	.12
Hydroxide (c'stic potash) dr., lb	.07 –	.07½
Muriate, 60%, bags, unit	.53½–	......
Nitrate, ref., bbl., lb	.08 –	.09
Permanganate, drums, lb	.19½–	.20
Prussiate, yellow, casks, lb	.16 –	.17
Sal ammoniac, white, casks, lb	.0515–	.06
Salsoda, bbl., 100 lb	1.00 –	1.05
Salt cake, bulk, ton	15.00 –	......
Soda ash, light, 58%, bags, contract, 100 lb	1.05 –	......
Dense, bags, 100 lb	1.15 –	......
Soda, caustic, 76% solid, drums, 100 lb	2.30 –	3.00
Acetate, del., bbl., lb	.05½–	.06
Bicarbonate, bbl., 100 lb	1.70 –	2.00
Bichromate, bags, lb	.07¼–	.08
Bisulphate, bulk, ton	16.00 –	17.00
Bisulphite, bbl., lb	.03 –	.04

VULCAN HOME OFFICE AND PLANT IN CINCINNATI

CHEM. & MET.

Weighted Index of Prices for

OILS & FATS

Base = 100 for 1937

This month	**145.63**
Last month	145.63
February, 1945	145.63
February, 1944	145.24

Chlorate, kegs, lb	$0.06½ -	$0.06¾
Cyanide, cases, dom., lb	.14¼ -	.15
Fluoride, bbl., lb	.07 -	.08
Hyposulphite, bags, 100 lb	2.25 -	2.50
Metasilicate, bbl., 100 lb	2.50 -	2.65
Nitrate, bulk, ton	27.00 -	....
Nitrite, casks, lb	.06¼ -	.07
Phosphate, tribasic, bags, 100 lb	2.[illegible]0 -	....
Prussiate, yel., bags, lb	.10½ -	.11
Silicate, 40°, dr., wks., 100 lb	.80 -	.85
Sulphite, crys., bbl., lb	.02¼ -	.02½
Sulphur, crude at mine, long ton	16.00 -	....
Dioxide, cyl., lb	.07 -	.08
Dioxide, tanks, lb	.04 -	....
Tin crystals, bbl., lb	.39½ -	....
Zinc chloride, grain, bbl., lb	.05½ -	.06
Oxide, lead free, bags, lb	.07¼ -	....
Oxide, 5% leaded, bags, lb	.07¼ -	....
Sulphate, bbl., cwt	3.85 -	4.00

OILS AND FATS

Castor oil, No. 3 bbl., lb	$0.13¾ -	$0.14½
Chinawood oil, tanks, lb	.38¾ -	....
Coconut oil, ceylon, N. Y., lb	.0885 -	....
Corn oil crude, tanks (f.o.b. mill), lb.	.12¾ -	....
Cottonseed oil crude (f.o.b. mill), tanks, lb	.12¾ -	....
Linseed oil, raw, car lots, bbl., lb	.155 -	....
Palm, casks, lb	.0865 -	....
Peanut oil, crude, tanks (mill), lb	.12¾ -	....
Rapeseed oil, refined, bbl., lb	nom.	
Soybean, tanks, lb	.11¾ -	....
Menhaden, light, pressed, dr. lb	.13 -	....
Crude, tanks (f.o.b. factory) lb	.089 -	....
Grease, yellow, loose, lb	.08¾ -	....
Oleo stearine, lb	.09½ -	....
Oleo oil, No. 1, lb	.11½ -	....
Red oil, distilled, bbl., lb	.13 -	....
Tallow extra, loose, lb	.08¾ -	....

COAL-TAR PRODUCTS

Alpha-naphthol, crude, bbl., lb	$0.52 -	$0.55
Alpha-naphthylamine, bbl., lb	.32 -	.34
Aniline oil, drums, extra, lb	.11½ -	.12½
Aniline salts, bbl., lb	.22 -	.24
Benzaldehyde, tech., dr., lb	.45 -	.50
Benzidine base, bbl., lb	.70 -	.75
Benzoic acid, USP, kegs, lb	.54 -	.56
Benzol, 90%, tanks, works, gal	.15 -	....
Benzyl chloride, tech., dr., lb	.22 -	.24
Beta-naphthol, tech., drums, lb	.23 -	.24
Cresol, USP, dr., lb	.10¾ -	....
Cresylic acid, dr., wks., gal	.81 -	.83
Diphenyl, bbl., lb	.15 -	....
Diethylaniline, dr., lb	.40 -	.45
Dinitrotoluol, bbl., lb	.18 -	.19
Dinitrophenyl, bbl., lb	.22 -	.23
Dip oil, 15%, dr., gal	.23 -	.25
Diphenylamine, dr., f.o.b. wks., lb	.25 -	....
H acid, bbl., lb	.45 -	.50
Hydroquinone, bbl., lb	.90 -	....
Naphthalene, flake, bbl., lb	.07 -	.07½
Nitrobenzene, dr., lb	.08 -	.09
Para-cresol, bbl., lb	.41 -	....
Para-nitroaniline, bbl., lb	.42 -	.43
Phenol, USP, drums, lb	.10 -	.11
Picric acid, bbl., lb	.35 -	.40
Pyridine, dr., gal	1.55 -	1.60
Resorcinol, tech., kegs, lb	.65 -	.70
Salicylic acid, tech., bbl., lb	.26 -	.33
Solvent naphtha, w.w., tanks, gal	.26 -	....
Toludin, bbl., lb	.96 -	....
Toluol, drums, works, gal	.32 -	....
Xylol, com., tanks, gal	.25 -	....

MISCELLANEOUS

Casein, tech., bbl., lb	$0.24 -	$0.26
Dry colors		
Carbon gas, black (wks.), lb	.0365 -	.097
Prussian blue, bbl., lb	.36 -	.37
Ultramarine blue, bbl., lb	.11 -	.26
Chrome green, bbl., lb	.23 -	.33
Carmine, red, tins, lb	4.60 -	4.75
Para toner, lb	.75 -	.80
Vermilion, English, bbl., lb	2.50 -	2.60
Chrome, yellow, C.P., bbl., lb	.16 -	.17
Gum copal, Congo, bags, lb	.09 -	.55
Manila, bags, lb	.09 -	.15
Damar, Batavia, cases, lb	.10 -	.22
Kauri, cases, lb	.18 -	.60
Magnesite, calc., ton	64.00 -	....
Pumice stone, lump, bbl., lb	.05 -	.07
Rosin, H., 100 lb	7.43 -	....
Shellac, orange, fine, bags, lb	.46 -	....
Bleached, bonedry, bags, lb	.42½ -	....
T. N. bags, lb	.35½ -	....
Turpentine, gal	.93½ -	.94½

NEW CONSTRUCTION

	Current Projects		Cumulative 1946	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$540,000	$575,000	$540,000	$655,000
Middle Atlantic	156,000	1,160,000	696,000	1,300,000
South	2,040,000	3,175,000	9,790,000	13,855,000
Middle West	5,540,000	1,250,000	6,640,000	4,387,000
West of Mississippi	26,800,000	935,000	27,050,000	1,752,000
Far West	325,000	2,033,000	1,125,000	2,876,000
Canada	....	7,448,000	....	7,448,000
Total	$35,401,000	$16,576,000	$45,841,000	$32,273,000

PROPOSED WORK

Calif., Trona—American Potash & Chemical Co., Trona, plans to construct a laboratory. H. L. Gogerte Organization, 3123 West 8th St., Los Angeles, Archt. Estimated cost $250,000.

Conn., New London—Knox Glass Associates, Knox, Pa., plan to construct a factory at Calkins Park and Crescent St. Estimated cost $500,000.

Conn., Plainville—Myler Plastics Corp., c/o Bond & Goodwin, 601 West 26th St., New York City, plans to construct a factory here. Estimated cost $40,000.

Fla., Tarpon Springs—Victor Chemical Works, W. B. Brown, Exec. Vice-Pres., plans to construct an electrical elemental phosphorus plant here. Estimated cost $2,000,000.

La., Gretna—Southern Cotton Oil Co., Gretna, plans to construct a modern new refinery. Graham, Anderson, Probst & White, 80 East Jackson St., Chicago, Ill., Archts.

Md., Cumberland—Air Reduction Co., Inc., Lincoln Bldg., New York, N. Y., plans to construct a chemical plant here. Estimated cost $155,550.

O., Akron—Goodyear Tire & Rubber Co., 1144 East Market St., plans to construct a plant to convert vinyl chloride copolymers and other resins into films, etc. Estimated cost $3,000,000.

O., Brecksville—B. F. Goodrich Co., 500 Main St., Akron, plans to construct a rubber research and development laboratory. Austin Co., 16112 Euclid Ave., Cleveland, Cons. Engr. Estimated cost $1,500,000.

O., Toledo—Grasselli Chemical Co., Stickney Ave. and Metzinger Rd., plans to construct a factory building. Estimated cost $1,000,000.

Tex., Brownsville—Cathage Hydrocol, Inc. and United Gas Corp., Fairfield Ave., Shreveport, La., plans to construct a gasoline manufacturing plant here. Estimated cost $14,000,000.

Tex., Houston—Diamond Alkali Co., Pittsburgh, Pa., and Diamond Alkali Co. of Texas, subsidiary, 1006 Main St., plans to construct a chemical manufacturing plant. Estimated cost $6,000,000.

Tex., Houston—Kelly-Springfield Tire Co., 407 North Main St., plans to construct a tire manufacturing plant. Estimated cost $6,000,000.

Tex., Houston—Nyotex Chemicals, Inc., Esperson Bldg., plans to expand its chemical plant. Estimated cost $100,000.

Tex., Houston—Sherwin-Williams Paint Co., 2108 Preston Ave., plans to reconstruct its paint plant. Estimated cost $275,000.

Tex., Houston—United Gas Corp., United Gas Bldg., plans to construct a gas plant and improve its gas booster station. Estimated cost $250,000 and $175,000 respectively.

Wash., Chehalis—Callison's, Inc., 372 State St., plans to construct a percolating plant to distill drugs. Estimated cost $75,000.

Wis., Menasha—Marathon Paper Mills Co., River St., plans to construct a 1 story, 150x200 ft. factory addition. Allen, Koehler & Steffes, Zuelke Bldg., Appleton, Archt.

CONTRACTS AWARDED

Calif., Los Angeles—Premier Oil & Lead Works, 3950 Medford St., have awarded the contract for a 1 and 2 story warehouse, also a 2 story office building, to Austin Co., 777 East Washington Blvd. Estimated cost $500,000.

Calif., Los Angeles—Willard Storage Battery Co., 5700 East Olympic Blvd., has awarded the contract for an addition to its factory to Steed Bros., 714 Date Ave., Alhambra. Estimated cost $120,000.

Calif., South Pasadena—National Technical Laboratories, 820 Mission Rd., has awarded the contract for a 3 story factory and office building to C. L. Peck, 354 South Spring St., Los Angeles. Estimated cost $160,000.

Conn., Berlin—Stanley Chemical Div. of Stanley Works, Berlin, has awarded the contract for a 2 and a 2½ story factory to Hasson & Downes, 55 West Main St., New Britain, Conn. Estimated cost $75,000.

Ind., East Chicago—Sinclair Refining Co., 630 Fifth Ave., New York, N. Y., has awarded the contract for an oil refinery to C. F. Braun Co., 1000 South Fremant Ave., Alhambra, Calif. Estimated cost $1,000,000.

Kan., Pittsburg—W. S. Dickey Clay Products Co., Commerce Bldg., Kansas City, Mo., has awarded the contract for a sewer pipe plant to W. R. Grimshaw, Hunt Bldg., Tulsa, Okla. Estimated cost $785,000.

Mass., Attleboro—American Reinforced Paper Co., Starkey Ave., has awarded the contract for a factory to Austin Co., 19 Rector St., New York, N. Y. Estimated cost $500,000.

N. J., New Providence—Air Reduction Sales Co., Inc., 60 East 42nd St., New York, N. Y., has awarded the contract for the design and construction of an apparatus research laboratory near Summit, to Wigton Abbot Co., 1225 South Ave., Plainfield. Estimated cost $120,000.

O., Dayton—Dayton Rubber Manufacturing Co., 2342 West Riverview St., has awarded the contract for a factory to Charles H. Shook, Inc., 582 West Second St. Estimated cost $250,000.

Ore., Portland—Shell Oil Co., Terminal Sales Bldg., has awarded the contract for an asphalt refinery at Willbridge Terminal, to Bechtel Bros. & McCone, 155 Sansome St., San Francisco, Calif. Estimated cost $200,000.

Ore., West Linn—Crown Zellerbach Corp., Box 3384, Terminal Sta., Seattle, Wash., has awarded the contract for alterations and additions to its paper mill to L. H. Hoffman, 715 S. W. Columbia Blvd., Seattle. Estimated cost $1,000,000.

Pa., Marcus Hook—Sinclair Oil Co., 630 Fifth Ave., New York, N. Y., has awarded the contract for an oil refinery to C. F. Braun Co., 1000 South Fremont Ave., Alhambra, Calif. Estimated cost $1,000,000.

Pa., Philadelphia—Publicker Industries, 1429 Walnut St., has awarded the contract for the construction of a Butyl still tower to John P. Hallahan Co., 2015 Sansom St. Estimated cost $40,000.

S. C., Charleston—Naco Fertilizer Co., King St. Ext., has awarded the contract for a fertilizer and insecticide plant to Luria Steel & Trading Corp., 500 Fifth Ave., New York 18, N. Y. Estimated cost $175,000.

Tex., Dallas—Diamond Alkali Co., Box 5173, will construct a 2 story factory using its own forces. Estimated cost $40,000.

Tex., San Antonio—Alamo Pottery Co., Frio City Rd. and Malone St., will construct a ceramic factory addition using its own forces. Estimated cost $40,000.

Tex., San Antonio—Wallas Roofing Co., 136 Ellis Bean St., will construct six warehouse units by purchase and hire method. Estimated cost $70,000.

Utah, Salt Lake City—Wasatch Chemical Co., 2225 S. 5th St., E., has awarded the contract for the construction of a warehouse to Christiansen Bros., 55½ West 1st St., at $52,644.

W. Va., Parkersburg—American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y., has awarded the contract for a plant for Calco Div., Willow Island, to Turner Construction Co., 420 Lexington Ave., New York, N. Y. Estimated cost $3,000,000.

Que., Cap De La Madeleine—Canadian Titanium Pigments, Ltd., 630 Dorchester St., Montreal, Que., has awarded the contract for the construction of a plant for manufacture of titanium oxide and pigments to Fraser-Brace, Ltd., 360 St. James St., W., Montreal. Estimated cost $7,448,000.

GUIDE AND DIRECTORY

20th Exposition Chemical Industries

GRAND CENTRAL PALACE, NEW YORK CITY

FEBRUARY 25 through MARCH 2, 1946

ADVISORY COMMITTEE

M. C. WHITAKER, Chairman
Vice Pres., American Cyanamid Co.

C. R. ALEXANDER
Pres., Salesmen's Ass'n. of American Chemical Industry

RAYMOND F. BACON
Consulting Chemist

L. W. BASS
Pres., American Institute of Chemical Engineers

WALLACE COHOE
Pres., The Chemists' Club

HUGH CRAIG
Editor, "Oil, Paint & Drug Reporter"

J. V. N. DORR
Pres., The Dorr Company

SIDNEY D. KIRKPATRICK
Editor, "Chemical and Metallurgical Engineering"
Pres., The Electrochemical Society

C. S. MARVEL
Pres., American Chemical Society

WALTER J. MURPHY
Editor, "Industrial and Engineering Chemistry"

W. T. READ
National Roster
War Manpower Commission

CHARLES F. ROTH
Manager Exposition

E. K. STEVENS
Associate Mgr., Exposition

ROBERT L. TAYLOR
Editor, "Chemical Industries"

R. GORDON WALKER
Vice Pres., Oliver United Filters, Inc.

E. R. WEIDLEIN
Director, Mellon Institute

★ EXHIBITORS ★

	Space No.
Ace Company, The, Ocala, Florida	605
Ace Glass Incorporated, Vineland, N. J.	338
Acme Steel Company, 2840 Archer Ave., Chicago, 8, Ill.	427–428
Adel Precision Products Co., Burbank, Calif.	670
Aetna Scientific Company, 236 Broadway, Cambridge, 39, Mass.	260
Air & Refrigeration Corporation, 475 Fifth Ave., New York, 17, N. Y.	459–460
Alberene Stone Corporation of Virginia, 419 Fourth Ave., New York, 16, N. Y.	79
Alien Property Custodian—Div. of Patent Administration, 120 Broadway, Rm. 1963, New York, 5, N. Y.	571
Allegheny Ludlum Steel Corporation, Brackenridge, Pa.	296–297–298
Allis-Chalmers Manufacturing Company, Milwaukee, Wisc.	48–49–56
Alloy Steel Products Company, Linden, N. J.	651–652
Alsop Engineering Corporation, Milldale, Conn.	321–322
Aluminum Company of America, Pittsburgh, 19, Pa.	70–71
Amecco Chemicals, Inc., 60 E. 42nd St., New York, 17, N. Y.	648–649
American Air Filter Company, Inc., 1st & Central Aves., Louisville, 8, Ky.	489–490–491
American Chemical Society, 1155–16th St., N. W. Washington, D. C.	East Pt. 7
American Foundry Equipment Company, Mishawaka, Ind.	481 to 484
American Hard Rubber Company, 11 Mercer St., New York, 13, N. Y.	269–270
American Institute of Chemists, 60 E. 42nd St., New York, 17, N. Y.	2 E
American Instrument Company, 8010 Georgia Ave., Silver Spring, Md., N. Y. Off. 30 Church St., New York 7	334–335
American Machine & Metals, Inc., Tolhurst Centrifugals Division—East Moline, Ill.	68–69
American Meter Company, 60 E. 42nd St., New York, 17, N. Y.	39–40–41
American Platinum Works, The, 231 N.J.R.R.Ave., Newark, 5, N. J.	456
American Resinous Chemicals Corporation, Peabody, Mass.	35–36
American Smelting and Refining Company, 120 Broadway, New York, 5, N. Y.	23
American Tool & Machine Company, 1415 Hyde Park Ave., Boston, 36, Mass.	505
Amersil Company, Hillside, N. J.	454
Andrews Lead Construction Corporation, 120 Broadway, New York, 5, N. Y.	23
Angel & Co. Inc., H. Reeve, 7 Spruce St., New York, 7, N. Y.	340
Ansul Chemical Company, Marinette, Wisc.	82
Artisan Metal Products, Inc., Boston, Mass.	540–541–542
Associated Cooperage Industries of America, Inc., The 408 Olive St., St. Louis, Mo.	325
Atlas Powder Company, Wilmington, 99, Dela.	46–47
Bakelite Corporation, 300 Madison Ave., New York, 17, N. Y.	17–18
Baker and Company, 113 Astor St., Newark, 5, N. J.	451–452
Baker Perkins Inc., Saginaw, Mich.; N. Y. Off. 250 Park Ave. (17)	62–63
Barco Manufacturing Co., 1801 Winnemac Ave., Chicago, 40, Ill.	515
Bareco Oil Company, P. O. Box 2009, Tulsa, 2, Okla.	629–630
Barnstead Still and Sterilizer Co. Inc., 2 Lanesville Terrace, Forest Hills, Boston, 31, Mass.	225–226
Barrett-Cravens Company, 3255 W. 30th St., Chicago, 23, Ill.	232–233
Bartlett & Snow Company, The C. O., 6200 Harvard Ave., Cleveland, Ohio	487–488
Bemis Bro. Bag Co., 408 Pine St., St. Louis, 2, Mo.	275–276
Berger Manufacturing Division—Republic Steel Corporation, Canton, Ohio	434–435–436
Bird Machine Company, South Walpole, Mass.	535–536–543–544
Blackburn-Smith Mfg. Co. Inc., The, Seaboard Trust Bldg., Hoboken, N. J.	461 A
Black-Sivalls & Bryson, Inc., Kansas City, 3, Mo.	496
Blaw-Knox Division of Blaw-Knox Company, Inc., Pittsburgh, Pa.	13–14
Blickman, Inc., S., Weehawken, N. J.	474–475
Bossert Company, The, Utica, N. Y.	209
Bowen Engineering, Inc., Garwood, N. J.	461 B
Brabender Corporation, Rochelle Park, N. J.	287
Bramley Machinery Corporation, 15 Park Row, New York, 7, N. Y.	520–521
Buffalo Caster & Wheel Corp., Buffalo, N. Y.	638–639–640
Buflovak Equipment Division of Blaw-Knox Company, Buffalo, 11, N. Y.	6
Bump Pump Company, LaCrosse, Wisc.	240–241
Burling Instrument Company, 253 Springfield Ave., Newark, N. J.	403
Buschman Co., E. W., Cincinnati, Ohio	617
Cambridge Instrument Company, Inc., Grand Central Terminal, New York, 17, N. Y.	271–272
Carborundum Company, The, Niagara Falls, N. Y.	91
Carnegie-Illinois Steel Corporation, Pittsburgh, 30, Pa.	76–77
Carpenter Container Corporation, 137–41st St., Brooklyn, 32, N. Y.	239
Carpenter Steel Company, The, Kenilworth, N. J.	539
Carter Engineering Company, The, 123 N. Hazel St., Danville, Ill.	650
Carver, Fred S., 345 Hudson St., New York, 14, N. Y.	231
Cayne, Albert H., 264 Canal St., New York, 13, N. Y.	638–639–640
Centrifuge Mechanical Equipment, Inc., 19 Rector St., New York, 6, N. Y.	671
Chemical Engineering Catalog, 330 W. 42nd St., New York, 18, N. Y.	26–27
Chemical and Engineering News, 330 W. 42nd St., New York, 18, N. Y.	26–27
Chemical Equipment Preview, 737 N. Michigan Ave., Chicago, 11, Ill.	506
Chemical Industries, 522 Fifth Ave., New York, 18, N. Y.	28 E and 28 W
Chemical & Metallurgical Engineering, 330 W. 42nd St., New York, 18, N. Y.	42
Chemicolloid Laboratories, Inc., 44 Whitehall St., New York, 4, N. Y.	237–238
Chemists' Club, The, 52 E. 41st St., New York, 17, N. Y.	10
Clark-Cooper Company, Palmyra, N. Y.	670
Cleveland Worm & Gear Company, The, 3249 E. 80th St., Cleveland, 4, Ohio	502–503
Coaltoter Conveyor Co., Chicago, Ill.	638–639–640
Coleman Electric Company, 310 Madison St., Maywood, Ill.	339 and A
Combustion Engineering Company, Inc., Raymond Pulverizer Division, 1315 N. Branch St., Chicago, 22, Ill.	67
Commercial Solvents Corporation, 17 E. 42nd St., New York, 17, N. Y.	55
Consolidated Diesel Electric Corporation, 28 E. 135th St., New York, 35, N. Y.	414
Container Company, The, P. O. Box 310, Van Wert, Ohio	234–235–236
Continental Diamond Fibre Co., Newark, Dela.	51
Continental Equipment Corporation, 30 Church St., New York, 7, N. Y.	670
Cooper Alloy Foundry Co., The, Bloy St. & Ramsey Ave., Hillside, N. J.	565–566
Corning Glass Works, Corning, N. Y.	332–333–346–347
Crane Co., 836 S. Michigan Ave., Chicago, 5, Ill.	312–313
Culvert Division—Republic Steel Corporation, Cleveland, Ohio	434–435–436
Darco Corporation, 60 E. 42nd St., New York, 17, N. Y.	46–47
Davis Emergency Equipment Co., Inc., 45 Halleck St., Newark, N. J.	679
Davison Chemical Corporation, The, 20 Hopkins Pl., Baltimore, 3, Md.	636–637
DeBothezat Fans Division—American Machine and Metals, Inc., East Moline, Ill.	68–69
Denver Equipment Company, 1400 Seventeenth St. Denver, Colo.	507
Dicalite Company, The, 120 Wall St., New York, 5, N. Y.	86–87
Dorr Company, The, 570 Lexington Ave., New York, 22, N. Y.	64–65
Dow Chemical Company, The, Midland, Mich.	227 to 230
Duriron Company, Inc., The, Dayton, 1, Ohio	19–20

Index As Supplied by the Exposition Management

Index As Supplied by the Exposition Management

EXHIBITORS—Continued

SPACE NO.

Leslie Co., Lyndhurst, N. J. 676
Lever Co., Geo. C., 50 Church St., New York, 7, N. Y. .. 605
Lewis-Shepard Products, Inc., Watertown, 72, Mass. .. 277–278–279
Lithaloys Corporation, 444 Madison Ave., New York, 22, N. Y. 667–668
Lukens Steel Company and Subsidiaries, Coatesville, Pa. .... 558 to 563
Luzerne Rubber Company, The, Trenton, 9, N. J. 528–529

McGraw-Hill Publishing Company, Inc., 330 W. 42nd St. New York, 18, N. Y. 42
McIntyre Co, The, 15 Riverdale Ave., Newton, 58, Mass. 467
Macbeth Corporation, 227 W. 17th St., New York, 11, N. Y. 400
Magnus, Mabee & Reynard, Inc., 16 Desbrosses St., New York 13, N. Y. 480
Makepeace Company, David, Attleboro, Mass. 453
Marco Company, Inc., 3rd & Church Sts., Wilmington, 50, Dela. 646–647
Marlo Company, The, 434 Broadway, New York, 13, N. Y. 530
Marsh Stencil Machine Co., Belleville, Ill. 411
Martindale Electric Co., The, P. O. Box 617—Edgewater Branch, Cleveland, 7, O. 440
Materials and Methods, 330 W. 42nd St., New York, 18, N. Y. 26–27
Matheson Co., Inc., The., East Rutherford, N. J. 305
Meriam Instrument Co., The., 10920 Madison Ave., Cleveland, 2, Ohio 514
Metalab Equipment Corporation, 1529 Dean St., Brooklyn, 13, N. Y. 504
Metal-Glass Products Co., Belding, Mich. 425–426
Metal Industries Catalog, 330 W. 42nd St., New York 18, N. Y. 26–27
Metzgar Company, The Grand Rapids, Mich. 606
Mine Safety Appliances Company, Braddock, Thomas & Meade Sts., Pittsburgh 8, Pa. 210A-B-C
Mixing Equipment Co. Inc., 1024 Garson Ave., Rochester 9, N. Y. 273–274
Monarch Manufacturing Works, Inc., Salmon & Westmoreland Sts., Philadelphia 34, Pa. 201
Moto-True Company, The, 6536 Carnegie Ave., Cleveland 3, Ohio; N. Y. Off. 250 W. 57th St. (19) 603–604
Munn and Steele, Inc., 130 Lister Ave., Newark 5, N. J. .. 569

Nash Engineering Company, The, South Norwalk, Conn. . 16
National Carbon Company, Inc., Carbon Sales Division, 30 E. 42nd St., New York 17, N. Y. 30–31
National Engineering Company, 549 W. Washington Blvd., Chicago 6, Ill. 554–555
National Lead Company, 111 Broadway, New York 6, N. Y. 292–293
National Technical Laboratories, 820 Mission St., South Pasadena, Calif. 300–301–302
National Tube Company, Pittsburgh 30, Pa. 76–77
Neville Company, The, Neville Island, Pittsburgh 25, Pa. .. 547–548
Newark Wire Cloth Company, 351 Verona Ave., Newark 4, N. J. 83–84
New England Tank and Tower Company, Everett 49, Mass. 50
New England Trawler Equipment Co., Chelsea, Mass. 638–639–640
New Jersey Machine Corporation, Willow Ave. at 16th St., Hoboken, N. J. 485–486
Niagara Blower Company, 6 E. 45th St., New York 17, N. Y. 493–494–495
Niagara Filter Corporation, 3080 Main St., Buffalo 14, N. Y. 516–517–518
Niles Steel Products Division—Republic Steel Corporation, Niles, Ohio 434–435–436
Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, 6, Pa. 61
North American Philips Company, Inc., 100 E. 42nd St., New York 17, N. Y. 574
Norton Company, Worcester 6, Mass. 415–416–417

Ohio Chemical & Mfg. Co., The, E. 14th St. & Prospect Ave., Cleveland 15, Ohio 341
Ohio Gear Co., Cleveland, Ohio 617
Oliver United Filters, Inc., 33 W. 42nd St., New York 18, N. Y. 65–66
Omega Machine Company, 122 S. Michigan Ave., Chicago 3, Ill. 479

SPACE NO.

Owens-Corning Fiberglas Corporation, Toledo, Ohio. 437–438–439

Pacific Northwest, The C/o Tacoma Chamber of Commerce, Tacoma, Wash. 653–654
Pangborn Corporation, Hagerstown, Md. 75
Paper and Industrial Appliances, Inc., 122 E. 42nd St. New York 17, N. Y. 472–473
Parker Appliance Company, The, 17325 Euclid Ave., Cleveland 12, Ohio 21
Patron Transmission Company, 129 Grand St., New York 13, N. Y. .... 617 and 643
Patterson-Kelley Co., Inc., The, 101 Park Ave., New York 17, N. Y. 295
Pennsylvania Crusher Company, Liberty Trust Bldg., Broad and Arch Sts., Philadelphia 7, Pa. 631
PerfeKtum Products Company, 300 Fourth Ave., New York 10, N. Y. 215–216
Perkin-Elmer Corp., Glenbrook, Conn. 680
Permutit Company, The, 300 W. 42nd St., New York 18, N. Y. 663
Peterson and Company, Leonard, 1222 Fullerton Ave., Chicago 14, Ill. 442
Pfaudler Co., The, 89 East Ave., Rochester 4, N. Y. 72–73
Pfizer & Co., Inc., Chas., 81 Maiden Lane, New York 7, N. Y. 5
Philadelphia Gear Works, Inc., G. St. below Erie Ave., Philadelphia, Pa.; N. Y. Off. 330 W. 42nd St. (18) 78
Phillips Petroleum Company, 206 Osage, Bartlesville, Okla. 633–634
Photovolt Corporation, 95 Madison Ave., New York 16, N. Y. 285
Picker X-Ray Corporation, 300 Fourth Ave., New York 10, N. Y. 492
Pike & Company, E. W., Elizabeth, N. J. 406
Pioneer Rubber Company, The, Willard, Ohio 429
Pittsburgh Equitable Meter Company, 400 Lexington Ave., Pittsburgh 8, Pa. 61
Pneumatic Scale Corporation, Ltd., North Quincy 71, Mass. 22
Popper & Klein, Inc., 300 Fourth Ave., New York 10, N. Y. .... 215–216 and 260
Porter Company, Inc., H. K., Oliver Bldg., Pittsburgh, Pa. 256–257
Powell Co., The, Wm., 2503 Spring Grove Ave., Cincinnati 22, Ohio 54
Premier Mill Corporation, 218 Genesee St., Geneva, N. Y. 211
Pressed Steel Tank Company, Milwaukee 14, Wisc. .. 280–281–282
Proctor & Schwartz, Inc., 7th St. & Tabor Road, Philadelphia 20, Pa. 15
Productive Equipment Corporation, 2926 W. Lake St., Chicago 12, Ill. 549
Progressive Architecture, 330 W. 42nd St., New York 18, N. Y. 26–27
% Proportioneers, Inc. %, 9 Codding St., Providence 1, R. I. 477–478
Pulverizing Machinery Company, Chatham Road, Summit, N. J. 246–247
Putman Publishing Company, 737 N. Michigan Ave., Chicago 11, Ill. 506

Radio Corporation of America, Camden, N. J. .... 625 to 628
Rampell, A. S., 163–25th St., Brooklyn 32, N. Y. 613–614
Rapids-Standard Company, Inc., The, 11 W. 42nd St., New York 18, N. Y. .... 446 to 450
Raymond Pulverizer Division—Combustion Engineering Company, Inc., 1315 N. Branch St., Chicago 22, Ill.: N. Y. Off. 60 E. 42nd St. (17) 67
Read Machinery Co., Inc., York, Pa. 308–309
Reeves Pulley Co. of N. Y. Inc., 76 Dey St., New York 7, N. Y. 34
Reichhold Chemicals, Inc., 601 Woodward Heights Blvd., Detroit, Mich. 303–304
Reineveld Corporation, P. O. Box 391, Norristown, Pa. . 407
Reinhold Publishing Corporation, 330 W. 42nd St., New York 18, N. Y. 26–27
Reliance Electric and Engineering Company, The, 1068 Ivanhoe Road, Cleveland 10, Ohio 674–675
Republic Filters, Inc., 17 Stone St., Newark 4, N. J. 556–557
Republic Steel Corporation, 3100 E. 45th St., Cleveland 4, Ohio 434–435–436
Resisto Pipe and Valve Co., 103 Park Ave., New York 17, N. Y. 561–562
Richmond Manufacturing Company, Lockport, N. Y. 441

Index As Supplied by the Exposition Management

EXHIBITORS—Continued

SPACE NO.

Riverside & Dan River Cotton Mills, Inc., 40 Worth St., New York 13, N. Y. ... 662A
Ritter Products Corporation, Ritter Park, Rochester 3, N. Y. ... 33
Roebling's Sons Company, John A., Trenton 2, N. J. ... 203–204
Roy Pumps, Milton, 1300 N. Mermaid Ave., Chestnut Hill, Philadelphia 18, Pa. ... 433
Ruggles-Coles Engineering Company, York, Pa. ... 60
Russell Engineering Works, Inc., James, 9 Dewar St., Boston, Mass. ... 677

St. Regis Paper Company, 230 Park Ave., New York 17, N. Y. ... 531–532
Sarco Company, Inc., 475 Fifth Ave., New York 17, N. Y. ... 11
Sauereisen Cements Company, 1045 N. Canal St., Pittsburgh 15, Pa. ... 623
Schneible Company, Claude B., P. O. Box 502 Roosevelt Annex, Detroit 32, Mich. ... 421–422
Schutte & Koerting Company, 12th & Thompson Sts., Philadelphia 22, Pa. ... 319–320
Scientific Glass Apparatus Co., 49 Ackerman St., Bloomfield, N. J. ... 218–219–220
Sedberry, Inc., J. B., 941 Hickory St., Utica, N. Y. ... 209
Seederer-Kohlbusch, Inc., 27-29 S. VanBrunt St., Englewood, N. J. ... 336
Selas Corporation of America, Erie Ave. & D. St., Philadelphia 34, Pa. ... 533–534
Separations Engineering Corporation, 110 E. 42nd St., New York 17, N. Y. ... 52
Service Engineering Company, Summit, N. J. ... 657–658
Sharples Corporation, The, 23rd & Westmoreland Sts., Philadelphia 40, Pa. ... 58–59
Sheffield Farms Company, Inc., Chemurgic Division, 524 W. 57th St., New York 19, N. Y. ... 409
Sheldon & Company, E. H., Muskegon, Mich. ... 288–289
Sherburne Company, The, 67 W. 44th St., New York 18, N. Y. ... 644–645
Shriver & Company, Inc., T., 808 Hamilton St., Harrison, N. J. ... 12
Sivyer Steel Casting Company, 1675 S. 43rd St., Milwaukee, Wisc. ... 512–513
Sjostrom Company, John E., 1711 N. Tenth St., Philadelphia 22, Pa. ... 664
Sly Manufacturing Company, The, W. W., 4700 Train Ave., Cleveland 2, Ohio ... 612
Snell, Inc., Foster D., 305 Washington St., Brooklyn 1, N. Y. ... 37
Socony-Vacuum Oil Company, 26 Broadway, New York 4, N. Y. ... 258–259
Sonneborn Sons, Inc., L., 88 Lexington Ave., New York 16, N. Y. ... 601
Sparkler Manufacturing Company, Mundelein, Ill. ... 519
Speedline Equipment Co., Brooklyn, N. Y. ... 638–639–640
Speedways Conveyors, Buffalo, N. Y. ... 638–639–640
Sperry and Company, D. R., Batavia, Ill. ... 540–541–542
Sprout, Waldron & Co., Muncy, Pa. ... 550 to 553
Standard Scientific Supply Corp., 34 W. 4th St., New York 12, N. Y. ... 618
Stanley Company, A. B., 378 Stuart St., Boston 16, Mass. ... 624
Steel and Tubes Division—Republic Steel Corporation, Cleveland, Ohio ... 434–435–436
Steel-Parts Mfg. Co., Chicago, Ill. ... 617
Stokes Machine Company, F. J., Philadelphia 20, Pa. ... 80
Sturtevant Mill Company, Park & Clayton Sts., Dorchester, Boston 22, Mass. ... 669
Superior Electric Company, Bristol, Conn. ... 522–523
Sutton, Steele and Steele, Inc., Dallas, Texas ... 52
Swenson Evaporator Company—Div. of Whiting Corporation, Harvey, Ill. ... 43
Syntron Company, Homer City, Pa. ... 265–266

SPACE NO.

Taylor & Company, W. A., 7300 York Road, Baltimore 4, Md. ... 337
Tech Laboratories, 337 Central Ave., Jersey City 7, N. J. ... 400A
Tenny Engineering, Inc., 26 Avenue B., Newark 5, N. J. ... 678
Thomas Company, Arthur H., 230 S. 7th St., P. O. Box 779, Philadelphia 5, Pa. ... 665–666
Titanium Alloy Manufacturing Company, 111 Broadway, New York 6, N. Y. ... 207–208
Toledo Scale Company, Toledo 12, Ohio ... 44B
Tolhurst Centrifugals Division—American Machine & Metals, Inc., East Moline, Ill. ... 68–69
Trent Company, Harold E., Leverington Ave. & Wilde St., Manayunk, Philadelphia 27, Pa. ... 573
Triangle Package Machinery Co., 906 N. Spaulding Ave., Chicago 51, Ill. ... 564
Tri-Clover Machine Co., Kenosha, Wisc. ... 567–568
Tripard Mfg. Co., Inc., 38 Murray St., New York 7, N. Y. ... 411
Truscon Steel Company—Division Republic Steel Corporation, Youngstown, O. ... 434–435–436
Turbo-Mixer Corporation, 247 Park Ave., New York 17, N. Y. ... 326 to 331
Tyler Company, The, W. S., 3615 Superior Ave., Cleveland 14, Ohio ... 87–88

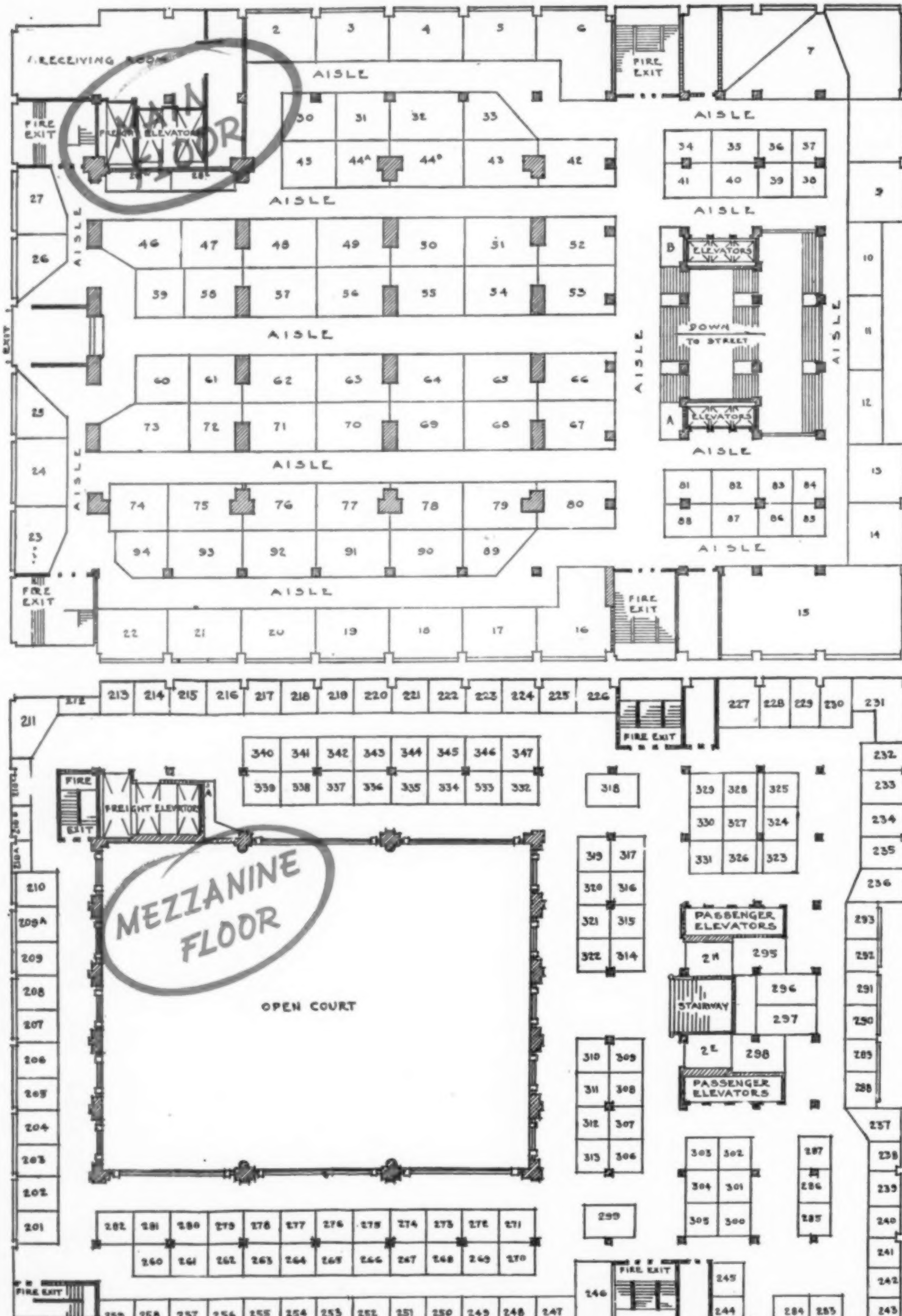
Uehling Instrument Company, 473 Getty Ave., Paterson, N. J. ... 202
Union Bag & Paper Corporation, Woolworth Bldg., New York 7, N. Y. ... 430
Union Carbide & Carbon Corporation, 30 E. 42nd St., New York 17, N. Y. ... 17–18–30–31 and 92
Union Drawn Steel Division—Republic Steel Corporation, Cleveland, Ohio ... 434–435–436
Union Gear & Machine Co., Boston, Mass. ... 617
United States Steel Corporation, 436 Seventh Ave., Pittsburgh 30, Pa. ... 76–77
United States Stoneware Co., 60 E. 42nd St., New York 17, N. Y. ... 89–90

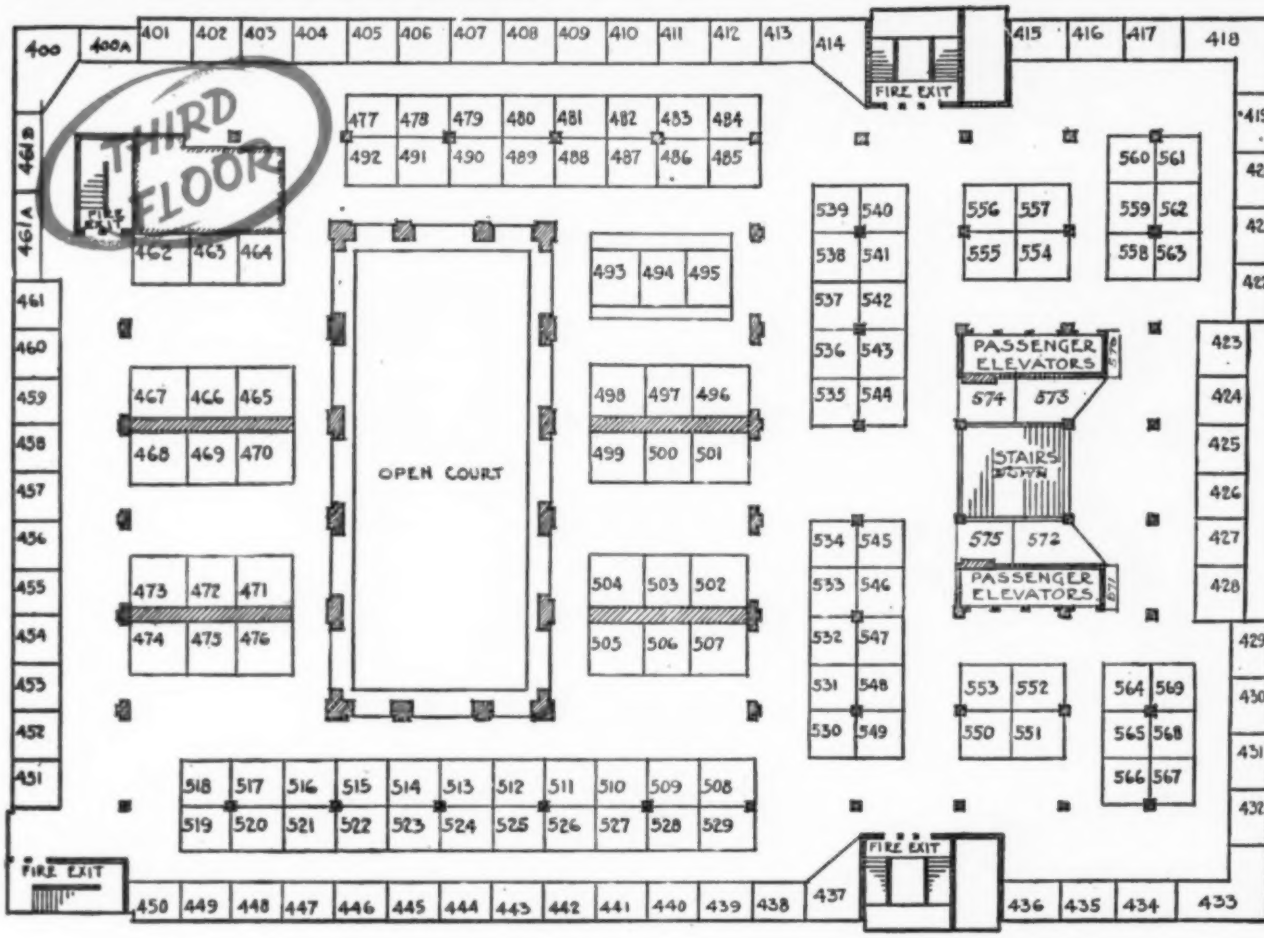
VanNostrand Company, Inc., D., 250 Fourth Ave., New York 3, N. Y. ... 85

Walker-Wallace Incorporated, 14 W. Utica St., Buffalo 9, N. Y. ... 572
Wallace & Tiernan Products, Inc., Belleville 9, N. J. ... 470
Walworth Company, 60 E. 42nd St., New York 17, N. Y. ... 254–255
Waterbury Tool—Division of Vickers Incorporated, Waterbury 91, Conn. ... 616
Waukesha Foundry Company, Waukesha, Wisc. ... 524 to 527
Welch Manufacturing Company, W. M., 1515 Sedgwick St., Chicago 10, Ill. ... 405
Welding Engineers, Inc., P. O. Box 391, Norristown, Pa. ... 408
West Bend Equipment Corp., West Bend, Wisc. ... 638–639–640
Whiting Corporation—Swenson Evaporator Company Division, Harvey, Ill. ... 43
Wiegand Company, Edwin L., 7500 Thomas Blvd., Pittsburgh 8, Pa. ... 498
Will Corporation, Rochester, N. Y.; N. Y. Off. 594 Broadway (12) ... 621
Williams Patent Crusher and Pulverizer Co., The, 2701 N. Broadway, St. Louis 6, Mo. ... 310–311
Willson Products, Inc., Reading, Pa. ... 431–432
Winthrop Chemical Company, Inc., Rensselaer, N. Y. ... 420
Worthington Pump and Machinery Corporation, Harrison, N. J. ... 267–268
Wright-Hibbard Industrial Electric Truck Co., Inc., Phelps, N. Y. ... 607 to 610

Yale & Towne Manufacturing Company, The, 4530 Tacony St., Philadelphia 24, Pa. ... 306–307

Index As Supplied by the Exposition Management


MAIN FLOOR
RECEIVING ROOM
FREIGHT ELEVATOR
FIRE EXIT
AISLE
ELEVATORS
DOWN TO STREET
MAIN ENTRANCE
LEXINGTON AVENUE
MEZZANINE FLOOR
OPEN COURT
PASSENGER ELEVATORS
STAIRWAY
FIRE EXIT
LEXINGTON AVENUE



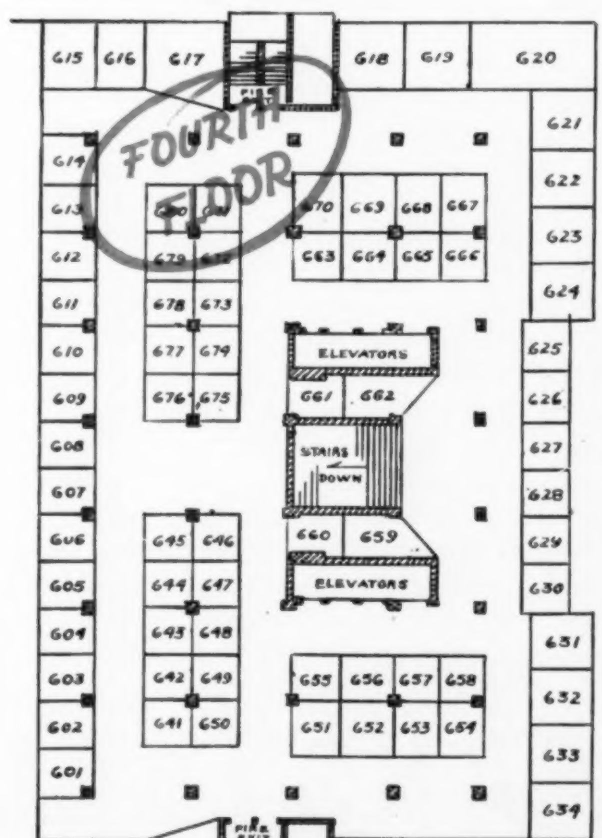
FLOOR PLANS

●

TWENTIETH EXPOSITION OF CHEMICAL INDUSTRIES

●

GRAND CENTRAL PALACE
NEW YORK CITY
FEBRUARY 25 TO MARCH 2-1946



EXHIBITORS

CLASSIFIED BY PRODUCTS

ABRASIVES
Carborundum Company (91)
Norton Company (415–417)
Pangborn Corp. (75)
Titanium Alloy Mfg. Co. (207–208)

ACIDS
Ansul Chemical Co. (82)
Atlas Powder Co. (46–47)
Dow Chemical Co. (227–230)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Hercules Powder Co. (7)
Industrial Products Co. (611)
Pfizer & Co. Inc., Chas. (5) organic

ACIDIFIERS
Eimer and Amend (57)
Fisher Scientific Co. (57)
General Ceramics and Steatite Corp. (2)
Glascote Products, Inc. (655–656)

ACID PLANTS
Ace Glass Incorporated (338)
American Smelting & Refining Co. (23)
Amersil Co. Inc. (454)
Baker & Co. (451–452)
Fansteel Metallurgical Corp. (314–317)
General Ceramics and Steatite Corp. (2)
Haveg Corp. (51)
Knight, Maurice A. (53)
National Lead Co. (292–293)
United States Stoneware Co. (89–90)

ACID RESISTING MATERIALS
Alloy Steel Products Co. (651–652)
Aluminum Company of America (70–71)
American Resinous Chemicals Corp. (35–36)
American Smelting and Refining Co. (23)
Amersil Co. Inc. (454)
Carpenter Steel Co. (539)
Cooper Alloy Foundry Co. (565–566)
Corning Glass Works (332–333—346–347)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Electro Chemical Supply & Engineering Co. (81)
Fansteel Metallurgical Corp. (314–317)
General Alloys Co. (299)
General Ceramics & Steatite Corp. (2)
Glascote Products Inc. (655–656)
Haveg Corp. (51)
Haynes Stellite Co. (92)
Heil Engineering Co. (575)
International Nickel Co. Inc. (9)
Janney Cylinder Co. (286)
Knight, Maurice A. (53)
Lapp Insulator Co. Inc. (418–419)
Lebanon Steel Foundry (465–466)
Luzerne Rubber Co. (528–529)
National Carbon Co. Inc. (30–31)
National Lead Co. (292–293)
Tri-Clover Machine Co. (567–568)
United States Steel Corp. (76–77)
United States Stoneware Co. (89–90)
Worthington Pump & Machinery Co. (267–268)

ADHESIVES
American Resinous Chemicals Corp. (35–36)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Hercules Powder Co. (7)
United States Stoneware Co. (89–90)

AGITATORS
Alsop Engineering Co. (321–322)
American Instrument Co. (334–335)
American Smelting and Refining Co. (23)
Centrifuge Mechanical Equipment, Inc. (671)
Dorr Company (64)
Eastern Engineering Co. (344–345)
Eimer and Amend (57)
Eppenbach, Inc. (318)
Ertel Engineering Corp. (508–509)
Fisher Scientific Co. (57)
General American Transportation Corp. (326–331)
General Ceramics and Steatite Corp. (2)
Glascote Products, Inc. (655–656)
Hardinge Co. Inc. (60)
Luzerne Rubber Co. (528–529)
Metal-Glass Products Co. (425–426)
Mixing Equipment Co. Inc. (273–274)
National Lead Co. (292–293)
New England Tank and Tower Co. (50)
Patterson-Kelley Co. Inc. (295)
H. K. Porter Co. Inc. (256–257)
Read Machinery Co. (308–309)
Sprout, Waldron & Co. (550–553)

AIR CONDITIONING APPARATUS
Air & Refrigeration Corp. (459–460)
American Instrument Co. (334–335)
Falstrom Co. (510–511)
Niagara Blower Co. (493–495)
Tenney Engineering, Inc. (678)

ALCOHOL
Commercial Solvents Corp. (55)
Dow Chemical Company (227–230)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Hercules Powder Co. (7)

ALKALIES
Dow Chemical Company (227–230)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Hercules Powder Co. (7)

ALLOYS—Ferrous
Carpenter Steel Co. (539)
Cooper Alloy Foundry Co. (565–566)
Duriron Co. Inc. (19–20)
Eimer and Amend (57)
Eriez Mfg. Co. (632)
Eutectic Welding Alloys Co. (462–464)
Fisher Scientific Co. (57)
General Alloys Co. (299)
Haynes Stellite Co. (92)
Lebanon Steel Foundry (465–466)
Lukens Steel Co. & Subsidiaries (558–563)
Republic Steel Corp. (434–436)
Sivyer Steel Casting Co. (512–513)
Titanium Alloy Mfg. Co. (207–208)
Tri-Clover Machine Co. (567–568)

ALLOYS—Non-ferrous
Aluminum Company of America (70–71)
American Platinum Works (456)
Baker & Co. (451–452)
Cooper Alloy Foundry Co. (565–566)
Dow Chemical Co. (227–230)
Eimer and Amend (57)
Eutectic Welding Alloys Co. (462–464)
Fansteel Metallurgical Corp. (314–317)
Fisher Scientific Co. (57)
Haynes Stellite Co. (92)
Hills-McCanna Co. (260–261)
International Nickel Co. Inc. (9)
Lithaloys Corp. (667–668)
D. E. Makepeace Co. (453)
National Lead Co. (292–293)
Titanium Alloy Mfg. Co. (207–208)
Tri-Clover Machine Co. (567–568)
Waukesha Foundry Co. (524–527)

ANODES
Aluminum Company of America (70–71)
American Platinum Works (456)
American Smelting & Refining Co. (23)
Baker & Co. (451–452)
Duriron Co. Inc. (19–20)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Heil Engineering Co. (575)
International Nickel Co. Inc. (9)
D. E. Makepeace Co. (453)
National Lead Co. (292–293)
United States Stoneware Co. (89–90)

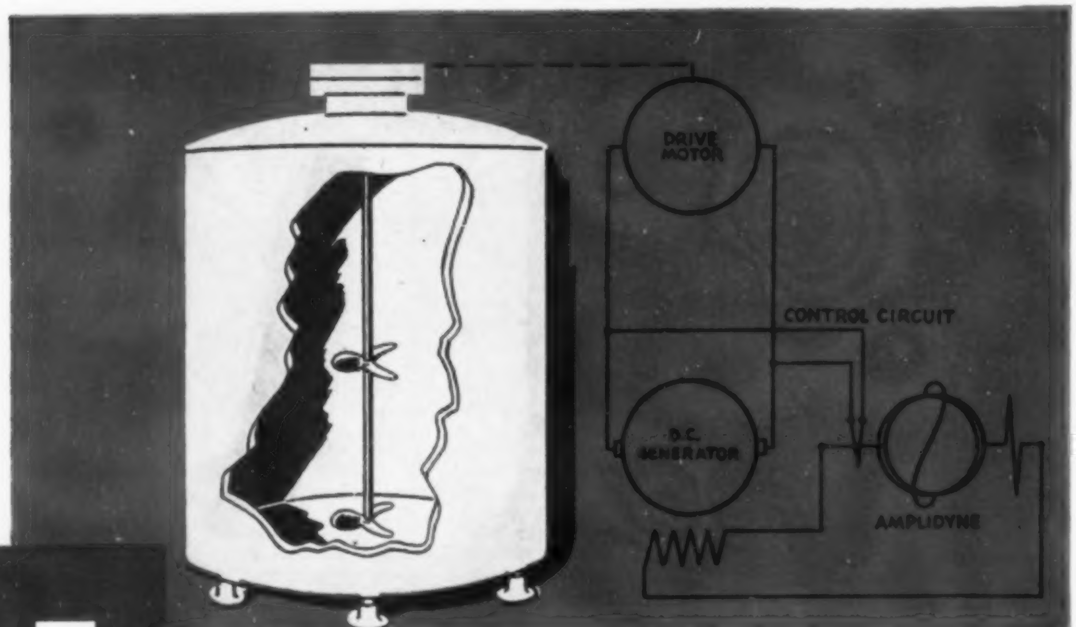
ASBESTOS
Eimer and Amend (57)
Ertel Engineering Corp. (508–509)
Fisher Scientific Co. (57)
Hercules Filter Corp. (443–445)
Johns-Manville (93–94)

AUTOCLAVES
Ace Glass Inc. (338)
Aetna Scientific Co. (262)
American Instrument Co. (334–335)
American Smelting and Refining Co. (23)
Artisan Metal Products Inc. (540–542)
C. O. Bartlett & Snow Co. (487–488)
Black, Sivalls & Bryson, Inc. (496)
Blaw-Knox Division of Blaw-Knox Co. Inc. (13–14)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Glascote Products, Inc. (655–656)
L. O. Koven & Brother, Inc. (248–249)
National Lead Co. (292–293)
New England Tank & Tower Co. (50)
Patterson-Kelley Co. Inc. (295)
Arthur H. Thomas Co. (665–666)
Harold E. Trent Co. (573)
W. M. Welch Mfg. Co. (405)
Will Corp. (621)

AUTOMATIC TEMPERATURE CONTROL
Ace Glass Incorporated (338)
American Instrument Co. (334–335)
Burling Instrument Co. (403)
Eclipse Fuel Engineering Co. (500)
Eimer and Amend (57)
Electric Hotpack Co. Inc. (642)
Charles Engelhard Inc. (455)
Fisher Scientific Co. (57)
Illinois Testing Laboratories, Inc. (38)
Niagara Blower Co. (493–495)
Sarco Co. Inc. (11)
Superior Electric Co. (522–523)
Tenney Engineering, Inc. (678)
Will Corp. (621)

(*Continued on page* 320)

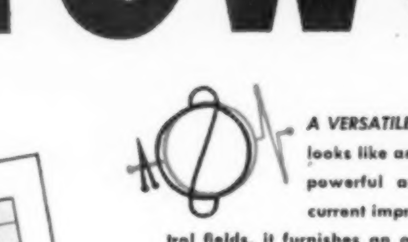
Compiled from information supplied to National Chemical Exposition.
No responsibility assumed for errors or omissions.



Farewell

A VERSATILE INDUSTRIAL TOOL, **the G-E amplidyne looks like an ordinary generator, yet performs as a powerful amplifier. Responding immediately to current impressed on one or more of its small control fields, it furnishes an output current sufficient to put control-field "orders" into effect instantaneously. On a mixer drive, amplidyne control produces the torque and speed characteristics charted at the left. Torque (solid black line) increases as shaft load increases, while motor speed (broken black line) shows a smooth, stepless descent. At maximum torque (X), motor will cut out, thereby preventing shaft damage.**

G-E amplidynes can give you similar operating advantages when applied to drives for grinding mills, rotary cutters, pulverizers, reactors, and other processing equipment. If you have a problem involving control of speed, torque, or a combination of the two, we'd like to show you how amplidyne can whip it.



EXHIBITORS • Classified by Products • CONTINUED

BAGS
Bemis Bros. Bag Co. (275-276)
Fulton Bag & Cotton Mills (424)
B. F. Gump Company (205-206)
St. Regis Paper Co. (531-532)
Union Bag & Paper Corp. (92)

BALANCES AND WEIGHTS
American Instrument Co. (334-335)
American Smelting and Refining Co. (23)
Eimer and Amend (57)
Exact Weight Scale Co. (476)
Fisher Scientific Co. (57)
National Lead Co. (292-293)
Scientific Glass Apparatus Co. (218-219)
Seederer-Kohlbusch, Inc. (336)
Standard Scientific Supply Co. (618)
Arthur H. Thomas Co. (665-666)
W. M. Welch Mfg. Co. (405)
Will Corp. (621)

BARRELS, DRUMS, & KEGS
Aluminum Company of America (70-71)
Associated Cooperage Industries of America, Inc. (325)
Carpenter Container Corp. (239)
Container Co., Division of Continental Can Co. Inc. (234-236)
B. F. Gump Co. (205-206)
Pressed Steel Tank Co. (280-282)
Republic Steel Corp. (434-436)

BASKETS, Dipping
American Hard Rubber Co. (269-270)
Falstrom Co. (510-511)
General Alloys Company (299)
Luzerne Rubber Co. (528-529)
United States Stoneware Co. (89-90)

BEARINGS
Aluminum Company of America (70-71)
Janney Cylinder Co. (286)
National Carbon Co. Inc. (30-31)
Patron Transmission Co. (617 & 643)
Reeves Pulley Co. of N. Y., Inc. (34)
Sprout, Waldron & Co. (550-553)

BELTS
Eimer and Amend (57)
Fisher Scientific Co. (57)
Reeves Pulley Co. of N. Y., Inc. (34)
Worthington Pump and Machinery Corp. (267-268)
Patron Transmission Co. (617 & 643)

BLAST EQUIPMENT—Sand
American Foundry Equipment Co. (481-484)
L. O. Koven & Brother, Inc. (248-249)
Pangborn Corp. (75)
W. W. Sly Mfg. Co. (612)

BLENDERS
% Proportioneers Inc. % (477-479)

BLOWERS
Ace Company (605)
American Instrument Co. (334-335) small
De Bothezat Fans Division American Machine & Metals, Inc. (68-69)
Eclipse Fuel Engineering Co. (500)
Eimer and Amend (57)
Fisher Scientific Co. (57)
General Ceramics and Steatite Corp. (2)
Kewaunee Mfg. Co. (250-253)
Metalab Equipment Corp. (504)
Niagara Blower Co. (493-495)
Pangborn Corp. (75) dust
Schutte & Koerting Co. (319-320)

BOILERS
Eclipse Fuel Engineering Co. (500)
Eimer and Amend (57)
Fisher Scientific Co. (57)
L. O. Koven & Bro., Inc. (248-249)

BOILER COVERING AND INSULATION
Dicalite Co. (86)
Munn & Steele, Inc. (569)
Owens-Corning Fiberglas Corp. (437-439)

BOLTING CLOTH
Eimer and Amend (57)
B. F. Gump Co. (205-206)
Newark Wire Cloth Co. (83-84)
Richmond Mfg. Co. (441)
Tyler Company, W. S. (88)

BOTTLING MACHINERY
Ertel Engineering Corp. (508-509)
Horix Mfg. Co. (412-413)
Karl Kiefer Machine Co. (24)
Pneumatic Scale Corp. Ltd. (22)

BRICK—Acid Proof
Electro Chemical Supply & Engineering Co. (81-82)
General Ceramics and Steatite Corp. (2)
Haveg Corp. (51)
Knight, Maurice A. (81-82)
National Carbon Co. Inc. (30-31) Carbon and graphite
United States Stoneware Co. (89-90)

BRICK—Insulating
Carborundum Co. (91)
Johns-Manville (93-94)
Munn & Steele, Inc. (569)
United States Stoneware Co. (89-90)

BRICK—Refractory
Carborundum Co. (91)
National Carbon Co. Inc. (30-31)
Norton Co. (415-417)
United States Stoneware Co. (89-90)

BRIQUETTING AND TABLET MAKING MACHINERY
Hydraulic Press Mfg. Co. (602)
Sprout, Waldron & Co. (550-553)
F. J. Stokes Machine Co. (80)

BUCKETS—Elevator
C. O. Bartlett & Snow Co. (487-488)
B. F. Gump Co. (205-206)
Luzerne Rubber Co. (528-529)
Omega Machine Co. (479)
Patron Transmission Co. (617 & 643)
Read Machinery Co. Inc. (308-309)

BUILDING MATERIALS
Johns-Manville (93-94)
Munn & Steele, Inc. (569)
National Lead Co. (292-293)

BURNERS
Amersil Co. Inc. (454) fused silica
Eclipse Fuel Engineering Co. (500)
Eimer and Amend (57)
Fansteel Metallurgical Corp. (314-317)
Fisher Scientific Co. (57)
Schutte & Koerting Co. (319-320)
Scientific Glass Apparatus Co. (218-220)
Selas Corporation of America (533-534)
Thomas Co., Arthur H. (665-666)
Will Corp. (621)

BUSHING AND ROLL COVERS
Janney Cylinder Co. (286)

CABINETS—Chemical, Filing and Laboratory
Alberene Stone Corp. of Virginia (79)
American Instrument Co. (334-335)
S. Blickman Inc. (474-475)
Eimer and Amend (57)
Falstrom Co. (46-47)
Fisher Scientific Co. (57)
Hamilton Mfg. Co. (244-245)
Kewaunee Mfg. Co. (250-253)
L. O. Koven & Brother, Inc. (248-249)
Metalab Equipment Co. (504)
Mine Safety Appliances Co. (210A-210B-210C)
Laboratory Furniture Co. Inc. (221-222)
Leonard Peterson & Co. Inc. (442)
Republic Steel Corp. (434-436)
E. H. Sheldon & Co. (288-289)
Sherburne Co. (644-645)
A. B. Stanley Co. (624)
Tenney Engineering, Inc. (678)
W. M. Welch Mfg. Co. (405)

CABLE
John A. Roebling's Sons Co. (203-204)

CALCINERS
C. O. Bartlett & Snow Co. (487-488)
General American Transportation Corp. (326-331)
Hardinge Co. Inc. (60)
National Lead Co. (292-293)

CALORIMETERS
Ace Glass Incorporated (338)
Eimer and Amend (57)
Thomas Co., Arthur H. (665-666)

CAMERAS
General Aniline & Film Corp. (619-620)

CARBON
Atlas Powder Co. (46-47)
Darco Corp. (46-47)
National Carbon Co. Inc. (30-31)

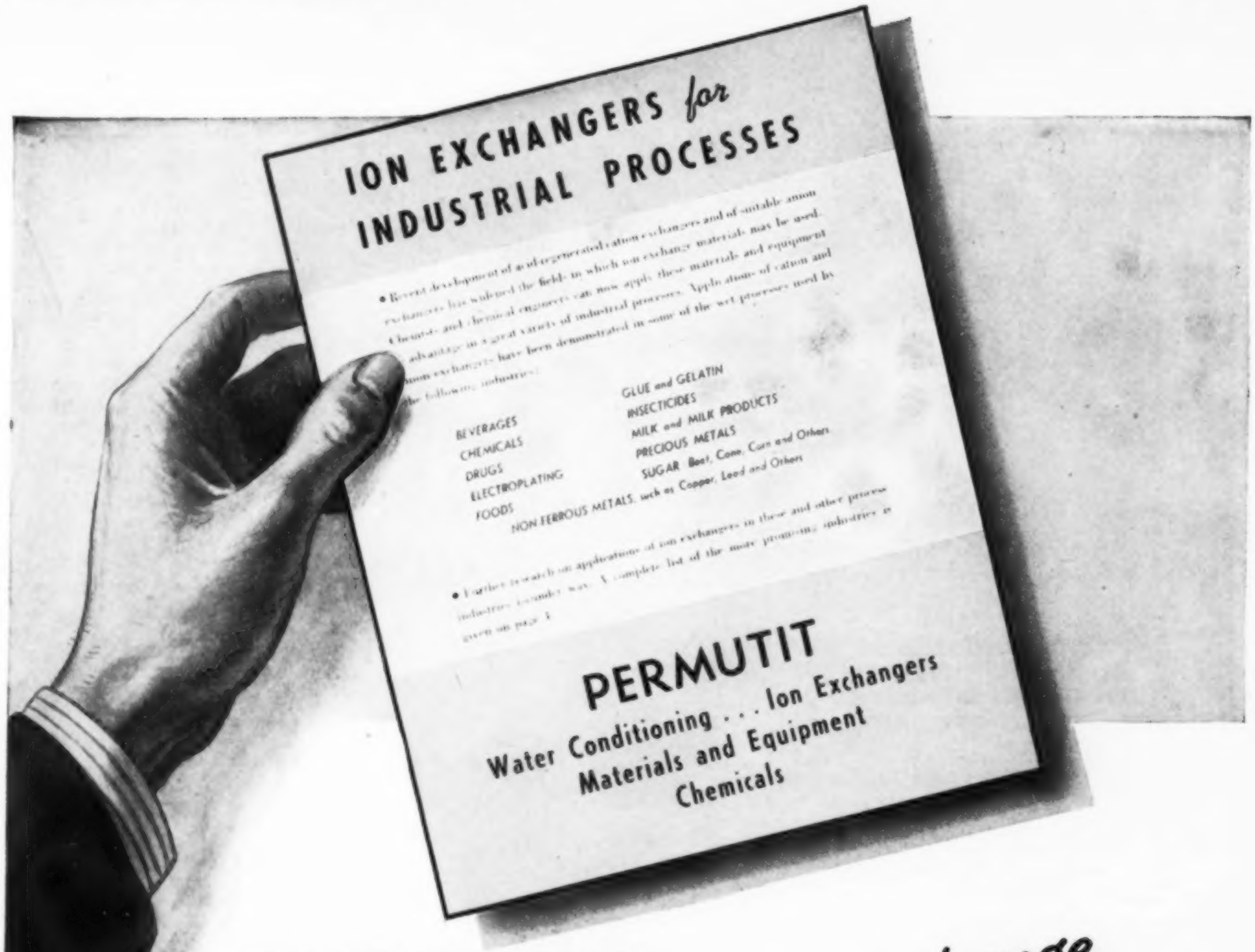
CARBOY TILTERS
Barrett-Cravens Co. (232-233)
Albert H. Cayne (638-640)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Industrial Products Co. (611)
Will Corp. (621)

CARS—Tank
General American Transportation Corp. (326-331)
International Nickel Co. Inc. (9)
National Lead Co. (292-293)

CASTINGS
Allegheny Ludlum Steel Corp. (296-298)
Aluminum Company of America (70-71)
American Smelting & Refining Co. (23)
Cooper Alloy Foundry Co. (565-566)
Duriron Co. Inc. (19-20)

(*Continued on page* 322)

Compiled from information supplied to National Chemical Exposition.
No responsibility assumed for errors or omissions.



HOW MANY OF THESE *New uses for Ion Exchange* ARE FAMILIAR TO YOU?

ION EXCHANGE has become a new unit process. Improved ion exchangers have extended the range of usefulness of this process far beyond the field of water treatment. Today chemists and chemical engineers apply the principles to a variety of industrial processes.

Ion exchangers have been used successfully in such diversified operations as the reduction of the calcium content of milk, and the manufacture of high quality pectin from grapefruit wastes. Some of the applications include:

a. *Removal* of undesirable impurities from solutions.

b. *Concentration* of valuable substances to make their recovery commercially feasible.

c. *Separation* of desired substances from each other.

d. *Catalysis* of chemical reactions.

e. *Substitution* of specific ions for other ions in solution.

If these suggest a way in which you can put the principles of ion exchange to commercial use, consult Permutit*. For more than 30 years Permutit has pioneered in the ion exchange industry. Whatever your wet process problem, you will receive intelligent, experienced cooperation. Send for booklet. Address The Permutit Company, Dept. C2, 330 West 42nd Street, New York 18, N. Y., or Permutit Co. of Canada, Ltd., Montreal.

*Trademark Reg. U. S. Pat. Off.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

Imagine—A Water of This Quality at Such Low Cost!

Permutit's Demineralizing Process produces a water which can be used in many applications where distilled water would otherwise be required. Yet the cost is only a fraction of the cost of distillation. Send for a free bulletin.

EXHIBITORS • Classified by Products • CONTINUED

Eriez Mfg. Co. (632)
Fansteel Metallurgical Corp. (314-317)
General Alloys Co. (299)
Haynes Stellite Co. (92)
Hills-McCanna Co. (260-261)
International Nickel Co. Inc. (9)
Janney Cylinder Co. (286)
Lebanon Steel Foundry (465-466)
National Lead Co. (292-293)
Sprout, Waldron & Co. (550-553)
United States Stoneware Co. (89-90)

CATALYST CHAMBERS

American Instrument Co. (334-335)

CAUSTIC POTS

Lukens Steel Co. & Subsidiaries (558-563)

CELLULOSE

Dow Chemical Company (227-230)
Hercules Powder Co. (621)

CEMENT

Carborundum Co. (91)
Electro Chemical Supply & Engineering Co. (81-82)
Haveg Corp. (51)
Knight, Maurice A. (53)
Norton Co. (415-417)
Owens-Corning Fiberglas Corp. (437-439)
Sauereisen Cements Co. (623)
United States Stoneware Co. (89-90)

CENTRIFUGALS

American Instrument Co. (334-335)
American Tool & Machine Co. (505)
Baker Perkins Inc. (62-63)
Bird Machine Co. (535-536—543-544)
Centrifuge Mechanical Equipment Inc. (671)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Sharples Corp. (58-59)
Thomas, Arthur H. (665-666)
Tolhurst Centrifugals Division American Machine & Metals, Inc. (68-69)
Will Corp. (621)

CERAMICS

General Ceramics and Steatite Corp. (2)
Illinois Electric Porcelain Co. (672-673)
Lapp Insulator Co. Inc. (418-419)
Selas Corporation of America (533-534)
Titanium Alloy Mfg. Co. (207-208)
United States Stoneware Co. (89-90)

CHEMICAL PLANT EQUIPMENT

Aetna Scientific Co. (262)
Alloy Steel Products Co. (651-652)
Aluminum Company of America (70-71)
American Foundry Equipment Co. (481-484)
American Hard Rubber Co. (269-270)
American Platinum Works (456)
American Smelting & Refining Co. (23)
Amersil Co. Inc. (454)
Artisan Metal Products Inc. (540-542)
Baker & Co. (451-452)
Baker Perkins Inc. (62-63)
C. O. Bartlett & Snow Co. (487-488)
Black, Sivalls & Bryson Inc. (496)
Blaw-Knox Division of Blaw-Knox Co. (13-14)
S. Blickman Inc. (474-475)
Bowen Engineering Inc. (461B)
Corning Glass Works (332-333—346-347)
Dorr Co. (64)
Duriron Co. Inc. (19-20)
Eimer and Amend (57)
Eppenbach Inc. (318)
Eriez Mfg. Co. (632)
Ertel Engineering Corp. (508-509)
Falstrom Co. (510-511)
Fansteel Metallurgical Corp. (314-317)
Fischer & Porter Co. (212-214)
Fisher Scientific Co. (57)
Foster Wheeler Corp. (3)
General American Transportation Corp. (326-331)
General Ceramics & Steatite Corp. (2)
Glascote Products Inc. (655-656)
B. F. Gump Co. (205-206)
Hardinge Co., Inc. (60)
Hasco Valve & Machine Co. (641)
Heil Engineering Co. (575)
Hercules Filter Corp. (443-445)
Illinois Electric Porcelain Co. (672-673)
L. O. Koven & Bro. Inc. (248-249)
La Bour Co. Inc. (32)
Lapp Insulator Co. Inc. (418-419)
Luzerne Rubber Co. (528-529)
Mixing Equipment Co. Inc. (273-274)
National Carbon Co. Inc. (30-31)
National Engineering Co. (554-555)
National Lead Co. (292-293)
National Technical Laboratories (300-302)
Omega Machine Co. (479)
Patterson-Kelley Co. Inc. (295)
Permutit Co. (663)
Pfaudler Co. (72-73)
H. K. Porter & Co. Inc. & Subsidiaries (256-257)
Pressed Steel Tank Co. (280-282)
Proctor & Schwartz Inc. (15)
% Proportioneers, Inc. % (477-479)
Pulverizing Machinery Co. (246-247)
Read Machinery Co. Inc. (308-309)
Reeves Pulley Co. of N. Y. Inc. (34)
Reineveld Corp. (407)
Republic Filters Inc. (556-557)
Richmond Mfg. Co. (441)
Milton Roy Pumps (433)
Schutte & Koerting Co, (319-320)
Selas Corp. of America (533-534)
Sherburne Co. (644-645)
Sprout, Waldron & Co. (550-553)
A. B. Stanley Co. (624)
F. J. Stokes Machine Co. (80)
Swenson Evaporator Co. (43)
Syntron Co. (265-266)
Tri-Clover Machine Co. (567-568)
Tyler Co., W. S. (88)
United States Stoneware Co. (89-90)
Wallace & Tiernan Products Inc. (470)
Welding Engineers Inc. (408)

CHEMICAL STONEWARE—Acid Proof

Eimer and Amend (57)
Fisher Scientific Co. (57)
General Ceramics & Steatite Corp. (2)
Illinois Electric Porcelain Co. (672-673)
Kewaunee Mfg. Co. (250-253)
Laboratory Furniture Co. Inc. (221-222)
Knight, Maurice A. (53)
Metalab Equipment Corp. (504)
A. B. Stanley Co. (624)
United States Stoneware Co. (89-90)

(*Continued on page* 324)

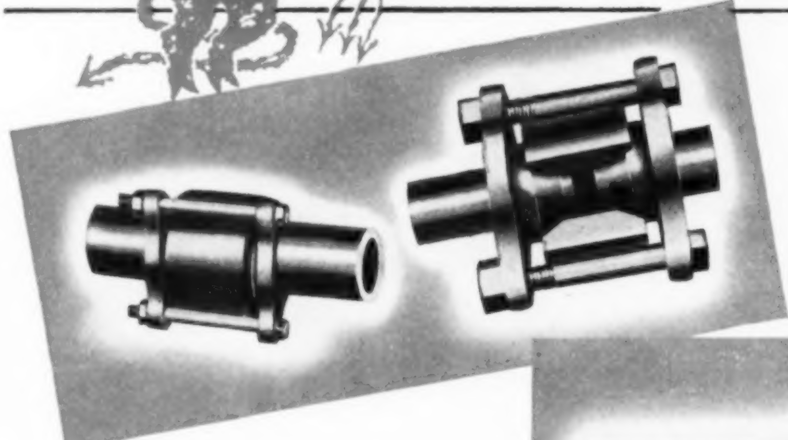
Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

FOUR STRONG NON-CORROSIVE

KARBATE

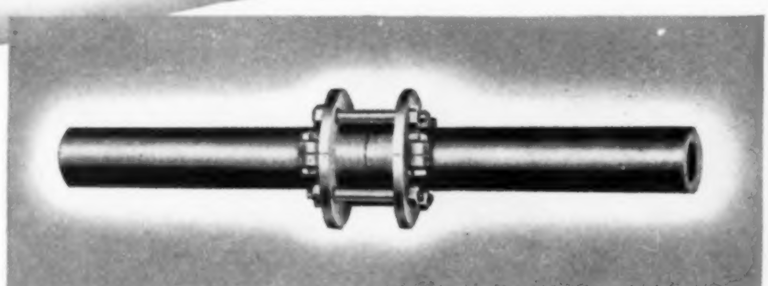
BRAND

EQUIPMENT CONNECTIONS



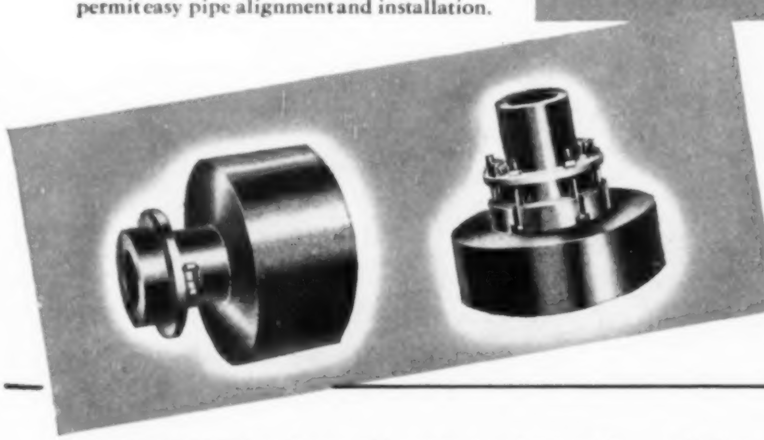
Type FC Flexible Coupling

Permits movement in any direction to protect "Karbate" piping from effects of vibration, misalignment, and differential expansion. Easily installed or dismantled on the job. Simplifies final pipe-length adjustment between pieces of equipment. Used with "Karbate" pre-assembled standard nipples and fittings, pipe may be cut to length and rapidly installed in the field.



Type V Flanged Connection

Thick, small-diameter collars provide sturdy construction. These can be used with companion flanges of almost any design or material. The separate cast-iron split flanges permit easy pipe alignment and installation.



Type V Nozzle
Type SC Slotted Coupler

Recommended for connections on "Karbate" tanks, towers, heat exchangers, and similar equipment. Generally installed at our factory—not particularly suitable for field installation. The Slotted Coupler is of more compact construction than the Type V Nozzle, but the choice of connection depends upon requirements of each job.

STRENGTH and ease of installation distinguish four improved "Karbate" chemically resistant equipment connections that are doing a first-rate job in many kinds of service.

Like the many "Karbate" specialty products used for **storage, conveying, handling,** and **processing** of corrosive liquids and gases, these connections are not only strong, but have high resistance to mechanical and thermal shock and to the action of most acids (notably hydrofluoric), alkalies, and other corrosive chemicals.

The designs of these connections are the result of years of experience of National Carbon Company, Inc., in furnishing "Karbate" impervious carbon or graphite equipment to the chemical, process, and other industries.

• • •

For additional information about "Karbate" equipment connections, write to our nearest Division Office for Catalog Section M-8805.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation
The words "National" and "Karbate" are registered trade-marks of National Carbon Company, Inc.

UCC

General Offices: 30 E. 42nd St., New York 17, N. Y.
Division Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

EXHIBITORS • Classified by Products • CONTINUED

(Continued on page 328)

Compiled from information supplied to National Chemical Exposition.
No responsibility assumed for errors or omissions.

EXHIBITORS • Classified by Products • CONTINUED

National Technical Laboratories (300–302)
Photovolt Corp. (285)
Scientific Glass Apparatus Co. (218–220)
Arthur H. Thomas Co. (665–666)
Wallace & Tiernan Products Inc. (470)
Will Corp. (621)

COLORS
Reichhold Chemicals, Inc. (303–304)

COMPARATORS
Eimer and Amend (57)
Fisher Scientific Co. (57)
Wallace & Tiernan Products, Inc. (470)
Will Corp. (621)

COMPRESSORS
Fuller Co. (263–264)
Janney Cylinder Co. (286)
New Jersey Machine Corp. (485–486)

CONCENTRATORS
Artisan Metal Products Inc. (540–542)
Centrifuge Mechanical Equipment Inc. (671)
Fansteel Metallurgical Corp. (314–317)
General American Transportation Corp. (326–331)
Koven & Bro. Inc., L. O. (248–249)
National Lead Co. (292–293)
Ritter Products, div. Ritter Co. Inc. (33)
Sharples Corp. (58–59)

CONDENSERS
Ace Glass Inc. (338)
Aetna Scientific Co. (262)
Aluminum Company of America (70–71)
Artisan Metal Products Inc. (540–542)
Blickman Inc., S. (474–475)
Eimer and Amend (57)
Fansteel Metallurgical Corp. (314–317)
General American Transportation Corp. (326–331)
Glascote Products, Inc. (655–656)
Koven & Bro. Inc., L. O. (248–249)
Niagara Blower Co. (493–495)
Owens-Corning Fiberglas Corp. (437–439)
Patterson-Kelley Co. Inc. (295)
Pfaudler Co. (72–73)
Schutte & Koerting Co. (319–320)
Scientific Glass Apparatus Co. (218–220)
National Carbon Co. Inc. (30–31)
National Lead Co. (292–293)

CONTACTORS
Eppenbach, Inc. (318)
New England Tank & Tower Co. (50)
Owens-Corning Fiberglas Corp. (437–439)
Sharples Corp. (58–59)

CONTROLLERS
American Instrument Co. (334–335)
Burling Instrument Co. (403)
Davis Emergency Equipment Co. Inc. (679)
Eclipse Fuel Engineering Co. (500)
Fischer & Porter Co. (212–214)
Hardinge Co. Inc. (60)
Leslie Co. (676)
Milton Roy Pumps (433)
Sarco Co. Inc. (11)
Selas Corp. of America (533–534)
Superior Electric Co. (522–523)

CONVEYING MACHINERY AND EQUIPMENT
Bartlett & Snow Co., C. O. (487–488)
Cayne, Albert H. (638–640)
Eriez Mfg. Co. (632)
Fuller Co. (263–264)
General Alloys Co. (299)
B. F. Gump Co. (205–206)
Hardinge Co. Inc. (60)
Horix Mfg. Co. (412–413)
Island Equipment Corp. (635)
Karl Kiefer Machine Co. (24)
National Engineering Co. (554–555)
Patron Transmission Co. (617 & 643)
Rapids-Standard Co. Inc. (446–450)
Reeves Pulley of N. Y. Inc. (34)
Sherburne Co. (644–645)
Sprout, Waldron & Co. (550–553)
Syntron Co. (265–266)
Triangle Package Machinery Co. (564)
United States Steel Corp. (76–77)

CONTAINERS
Aluminum Company of America (70–71)
Associated Cooperage Industries of America (325)
Carpenter Container Corp. (239)
Container Co. Division of Continental Can Co., Inc. (234–236)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Industrial Products Co. (611)
Kimble Glass Co. (342–343)
Koven & Bro., Inc., L. O. (248–249)
Luzerne Rubber Co. (528–529)
Makepeace Co., D. E. (453)
Metal-Glass Products Co. (425–426)
Pressed Steel Tank Co. (280–282)
Republic Steel Corp. (434–436)

CONTRACT MANUFACTURERS
Evans Chemetics, Inc. (461)

CONTROL APPARATUS
Ace Glass Inc. (338)
American Instrument Co. (334–335)
Burling Instrument Co. (403)
Coleman Electric Co. (339–A)
Continental Equipment Co. (670)
Davis Emergency Equipment Co. Inc. (679)
Exact Weight Scale Co. (476)
Fisher & Porter Co. (212–214)
National Technical Laboratories (300–302)
Omega Machine Co. (479)
% Proportioneers, Inc. % (477–479)
Reeves Pulley Co. of N. Y. Inc. (34)
Milton Roy Pumps (433)
Thomas Co., Arthur H. (665–666)
Will Corp. (621)

COOLERS
C. O. Bartlett & Snow Co. (487–488)
Corning Glass Works (332–333 346–347)
Fuller Co. (263–264)
General American Transportation Corp. (326–331)
Hardinge Co. Inc. (60)
National Carbon Co. Inc. (30–31)
Niagara Blower Co. (493–495)
Patterson-Kelly Co. Inc. (295)
Swenson-Evaporator Co Division of Whiting Corp. (43)

COOPERAGE
Associated Cooperage Industries of America Inc. (325)
Pressed Steel Tank Co. (280–282)

(*Continued on page* 332)

Compiled from information supplied to National Chemical Exposition.
No responsibility assumed for errors or omissions.

Open type illustrated; hooded vacuum and enclosed pressure types available.

The "Precoat" Filter has greatly broadened the application of continuous filtration. It is designed for use with a "precoat" or pre-formed cake of microporous permeable material such as diatomaceous earth; products handled are especially those containing sticky, slimy, cloth-binding solids or solutions with low solids content; cake is usually discarded; outstanding features are fresh surface of precoat at all times for filtering and long filtering cycle.

The "Panel" Filter also has broadened the scope of continuous vacuum filtration. Complementing the Precöat Filter, it, too, is designed to handle slow filtering products forming sticky or slimy cakes difficult to remove from the filter cloth. No wire winding is used to hold the cloth in place. An ingenious adjustable, floating wire discharger contacts the cloth very lightly to remove the cake. Cake can be saved as no filter aid need be used.

The "Horizontal Rotary", a distinctly different type of "continuous" filter, is designed to handle products with coarse, granular solids. It is especially effective as a combined washing and dewatering unit. Separate washes can be applied and separate filtrates recovered, both without mixing. Series washing can be applied. All operations are visible. Gravity aids removal of liquor.

OLIVER UNITED FILTERS INC.

New York 18, N. Y.
33 West 42nd Street

San Francisco 11,
California

Chicago 1, Illinois
221 N. LaSalle Street

Western Sales Division
2900 Glascock Street
Oakland 1, Calif.

Sales & Manufacturing Representative: E. Long Limited, Orillia, Canada

Factories: Oakland, Calif. • Hazleton, Pa. • Orillia, Canada • Melbourne, Australia

EXHIBITORS • Classified by Products • CONTINUED

COSMETICS
Evans Chemetics, Inc. (461)

COUNTING MACHINES
Marlo Co. (530)

COUPLINGS
Hardinge Co. Inc. (60)
Lukens Steel Co. & Subsidiaries (558–563)
Marco Co. Inc. (646–647)
United States Stoneware Co. (89–90)

CRUCIBLES
Amersil Co. Inc. (454)
Baker & Co. (451–452)
Eclipse Fuel Engineering Co. (500)
Eimer and Amend (57)
Fisher Scientific Co. (57)
National Carbon Co. Inc. (30–31) graphite
Norton Co. (415–417)
Thomas Co., Arthur H. (665–666)
Will Corp. (621)

CRUSHERS, GRINDING MILLS AND PULVERIZERS
American Instrument Co. (334–335)
Bartlett & Snow Co., C. O. (487–488)
Bramley Machinery Corp. (520–521)
Eimer and Amend (57)
Eppenbach, Inc. (318)
Fisher Scientific Co. (57)
Fitzpatrick Co. Inc., W. J. (401–402)
Hardinge Co. Inc. (60)
Jay Bee Sales Co. (209)
Porter Co. Inc., H. K. & Subsidiaries (256–257)
Pulverizing Machinery Co. (246–247)
Raymond Pulverizer Division of Combustion Engineering Co. (67)
Sprout, Waldron & Co. (550–553)
Thomas Co., Arthur H. (665–666)
Will Corp. (621)
Williams Patent Crusher & Pulverizer Co. (310–311)

CRYSTALLIZING EQUIPMENT
Aluminum Company of America (70–71)
Artisan Metal Products Inc. (540–542)
Koven & Bro., Inc., L. O. (248–249)
Pfaudler Co. (72–73)
Porter Co. Inc., H. K. & Subsidiaries (256–257)
Swenson Evaporator Co., Division of Whiting Corp. (43)

CYLINDERS FOR HIGH PRESSURE GASES
Eimer and Amend (57)
Fisher Scientific Co. (57)
Pressed Steel Tank Co. (280–282)

CO2 RECORDERS
Davis Emergency Equipment Co. Inc. (679)
Eimer and Amend (57)
Engelhard, Inc., Chas (455)
Fisher Scientific Co. (57)
Permutit Co. (663)
Will Corp. (621)

DEAERATORS
Permutit co. (663)

DECOLORIZATION AND PURIFYING MATERIALS
Ansul Chemical Co. (82)
Atlas Powder Co. (46–47)
Darco Corp. (46–47)
Ertel Engineering Corp. (508–509)
Lithaloys Corp. (667–668)
Permutit co. (663)
Wallace & Tiernan Products, Inc. (470)

DEGASIFIERS
Permutit co. (663)

DEMINERALIZERS
Barnstead Still & Sterilizer Co. Inc. (225–226)

DETERGENTS
American Resinous Chemicals Corp. (35–36)
Atlas Powder Co. (46–47)
Dow Chemical Company (227–230)
Glyco Products Co. Inc. (223–224)
Hercules Powder Co. (7)
Standard Scientific Supply Corp. (618)
Winthrop Chemical Co. Inc. (420)

DIESEL ENGINES
Consolidated Diesel Electric Corp. (414)

DIGESTERS
Blaw-Knox Division of Blaw-Knox Co. (13–14)
Dorr Co. (64)
Fansteel Metallurgical Corp. (314–317)
Hardinge Co. Inc. (60)
Koven & Bro., Inc., L. O. (248–249)
National Lead Co. (292–293)
Pfaudler Co. (72–73)
Porter Co., H. K., Inc. & Subsidiaries (256–257)

DISSOLVERS
Eppenbach, Inc. (318)
General Ceramics & Steatite Corp. (2)
Koven & Bro., Inc., L. O. (248–249)
New England Tank & Tower Co. (50)
Porter Co. Inc., H. K. & Subsidiaries (256–257)

DISTILLING MACHINERY AND APPARATUS
Ace Glass Inc. (338)
Aetna Scientific Co. (80)
American Instrument Co. (334–335)
Amersil Co. Inc. (454)
Artisan Metal Products Inc. (540–542)
Barnstead Still and Sterilizer Co., Inc. (225–226)
Eimer and Amend (57)
Fansteel Metallurgical Corp. (314–317)
Fischer & Porter Co. (212–214)
Fisher Scientific Co. (57)
General Ceramics & Steatite Corp. (2) Stoneware
Glascote Products, Inc. (655–656)
Hercules Filter Corp. (443–445)
Koven & Bro., Inc., L. O. (248–249)
Patterson-Kelley Co., Inc. (295)
Pfaudler Co. (72–73)
Scientific Glass Apparatus Co. (218–220)
Stokes Machine Co., F. J. (80)
Thomas Co., Arthur H. (665–666)
Will Corp. (621)

DRIVES
Glascote Products, Inc. (655–656)
Mixing Equipment Co. Inc. (273–274)

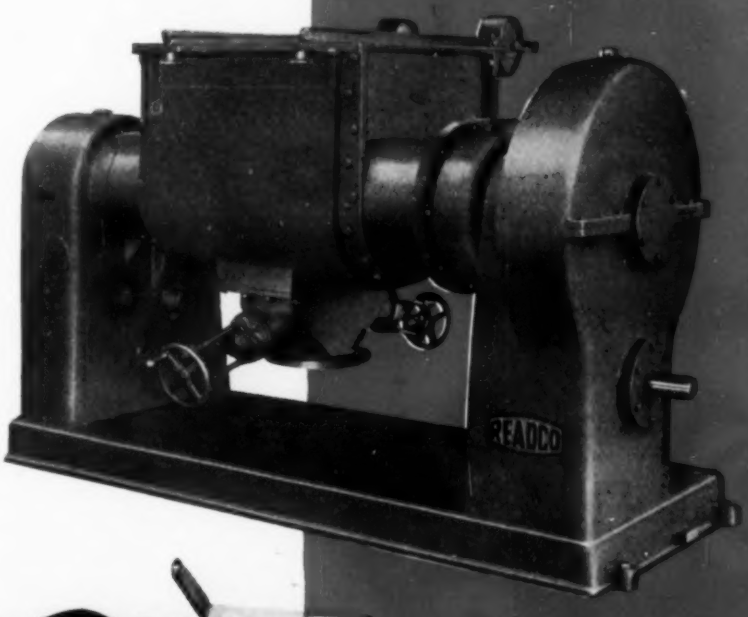
(*Continued on page 336*)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

EPENDABILITY

IXING . . .

NGLE PACKING GLAND DOUBLE ARM CUUM MIXERS . . . Contamination or oxidiza- is eliminated by single packing gland construction. t seals, an exclusive READCO feature, mounted on arm shafts at the bowl ends, are easily removed for ning. Overlapping or tangential action mixing arms inate dead spots. Arm speeds are provided to suit uirements, multi-speed or variable speed if desired. perature control is arranged for by means of full, ial or divided jackets on the bowl. The adjustable er is mounted to provide perfect sealing at all times. t in a range of sizes from $2\frac{1}{2}$ to 1,200 gallon capaci- with tilting bowl discharge (top illustration) or bot- discharge (center illustration).



BORATORY MIXERS . . . Easily dismantled quick cleaning to eliminate contamination. Variety nixing arms are interchangeable. Built in working acities of 1, 3 and 6 quarts. (Illustrated on bottom)

EADCO ENGINEERING ERVICE and EQUIPMENT

ABORATORY FACILITIES . . . are maintained for the develop- ent of new ideas . . . for the testing of customers' materials . . for the continuous improvement of READCO equipment.

KILLED ENGINEERING STAFFS . . . with practical knowl- dge and engineering "know how" are better prepared than ver before to assist you in planning and building your rocess equipment.

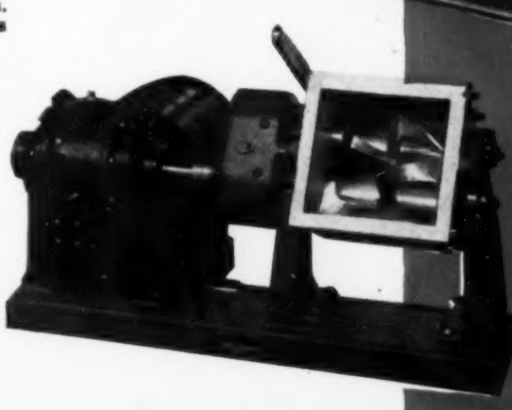
ODERN MANUFACTURING FACILITIES . . . have been ex- anded to fulfill the exacting demands of modern production. hese facilities will provide you with better chemical process uipment.

ALES PERSONNEL . . . are anxious to be of service to ou far beyond the effort of merely selling equipment.

RACTICAL FIELD SERVICE STAFF . . . is factory ained and experienced to supervise erection and ser- ce of READCO equipment.

FFICIENT MANAGEMENT . . . stands behind the guar- ntee of performance on every piece of READCO uipment.

hese exceptional facilities, plus the accumulated know-how" of thirty-eight years including the experi- nce of the war emergency, enable READCO to offer ou many new improvements in chemical process uipment . . . sound reasons why you should plan w to consult with READCO engineers. Write READCO day for a complete new chemical and industrial proc- sing equipment catalog.



MATERIAL HANDLING | PILOT PLANT MIXER | LABORATORY MIXER | BLENDING & MIXING | PLANETARY MIXING

READ MACHINERY CO., Inc.

EXHIBITORS • Classified by Products • CONTINUED

New England Tank & Tower Co. (50)
Patron Transmission Co. (617 & 643)
Reeves Pulley Co. of N. Y. Inc. (34)
Waterbury Tool Division of Vickers Incorporated (616)
Worthington Pump & Machinery Corp. (267-268)

DRYERS, CENTRIFUGAL

Baker Perkins Inc. (62-63)
Bird Machine Co. (535-536 543-544)
Fletcher Works Inc. (25)
Tolhurst Centrifugals Division of American Machine & Metals, Inc. (68-69)

DRYING MACHINERY AND EQUIPMENT

Artisan Metal Products Inc. (540-542)
Bartlett & Snow Co., C. O. (487-488)
Bird Machine Co. (535-536 543-544)
Blaw-Knox Division of Blaw-Knox Co. (13-14)
Bowen Engineering Inc. (461B)
Federal Classifier Systems Inc. (404)
General American Transportation Corp. (326-331)
Hardinge Co., Inc. (60)
Hersey Mfg. Co. (499)
Lukens Steel Co. & Subsidiaries (558-563)
National Engineering Co. (554-555)
Pfaudler Co. (72-73)
Porter Co. Inc., H. K. & Subsidiaries (256-257)
Proctor & Schwartz Inc. (15)
Raymond Pulverizer Division of Combustion Engineering Co. (67)
Reeves Pulley Co. of N. Y. Inc. (34)
Selas Corp. of America (533-534)
Stokee Machine Co., F. J. (80)
Swenson Evaporator Co. Division of Whiting Corp. (43)
Trent Co., Harold E. (573)

DRUMS

Artisan Metal Products Inc. (540-542)
Blaw-Knox Division of Blaw-Knox Co. (13-14)
Container Co. Division of Continental Can Co. Inc. (234-236)
Koven & Bro., Inc., L. O. (248-249)
Lukens Steel Co. & Subsidiaries (558-563)
Porter Co. Inc., H. K. (256-257)
Stokes Machine Co., F. J. (80)
Swenson Evaporator Co. (43)

DUST & FUME COLLECTING SYSTEMS

American Air Filter Co. Inc. (489-491)
American Foundry Equipment Co. (481-484)
Bartlett & Snow Co., C. O. (487-488)
DeBothezat Fans Division of American Machine & Metals Inc. (68-69)
Falstrom Co. (510-511)
Federal Classifier Systems, Inc. (404)
Metalab Equipment Corp. (504)
Pangborn Corp. (75)
Schneible Co., Claude B. (421-422)
Sly Mfg. Co., W. W. (612)
Stanley Co., A. B. (624)

DUST SAMPLING EQUIPMENT

Mine Safety Appliances Co. (210A-210B-210C)

DUST AND SPRAY MASKS

Davis Emergency Equipment Co. Inc. (679)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Martindale Electric Co. (440)
Mine Safety Appliances Co. (210A-210B-210C)

EJECTORS

Blackburn-Smith Mfg. Co. Inc. (461A)
Duriron Co. Inc. (19-20)
Eimer and Amend (57)
Exact Weight Scale Co. (476)
Fisher Scientific Co. (57)
Illinois Electric Porcelain Co. (672-673)
Schutte & Koerting Co. (319-320)
Worthington Pump & Machinery Corp. (267-268)
National Carbon Co. Inc. (30-31)

ELECTRICAL INSTRUMENTS

Industrial Instruments Inc. (410)

ELECTRONIC EQUIPMENT

Coleman Electric Co. (339A)
Davis Emergency Equipment Co. Inc. (679)
Exact Weight Scale Co. (476)
Fischer & Porter Co. (212-214)
National Technical Laboratories (300-302)
North American Philips Co. Inc. (433)
Photovolt Corp. (285)
Milton Roy Pumps (433)
Superior Electric Co. (522-523)
Syntron Co. (265-266)
Thomas Co., Arthur H. (665-666)
Will Corp. (621)

ELEVATORS

Barrett-Cravens Co. (232-233)
C. O. Bartlett & Snow Co. (487-488)
General Ceramics and Steatite Corp. (2)
B. F. Gump Co. (205-206)
Lewis-Shepard Products Inc. (277-279)
Moto-Truc Co. (603-604)
National Engineering Co. (554-555)
Sprout, Waldron & Co. (550-553)

EMULSIFIERS

American Resinous Chemicals Corp. (35-36)
Atlas Powder Co. (46-47)
Centrifuge Mechanical Equipment Inc. (671)
Dorr Co. (64)
Eppenbach, Inc. (318)
Glyco Products Co. Inc. (223-224)
Hercules Powder Co. (7)
Mixing Equipment Co., Inc. (273-274)
Porter Co. Inc., H. K. & Subsidiaries (255-257)
Sharples Corp. (58-59)
Will Corp. (621)

EMULSIONS

American Resinous Chemicals Corp. (35-36)
Atlas Powder Co. (46-47)
Dow Chemical Company (227-230)
Eppenbach, Inc. (318)
Glyco Products Co. Inc. (223-224)
Neville Co. (547-548)

ENAMELED APPARATUS

Glascote Products, Inc. (655-656)
Pfaudler Co. (72-73)

(Continued on page 340)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

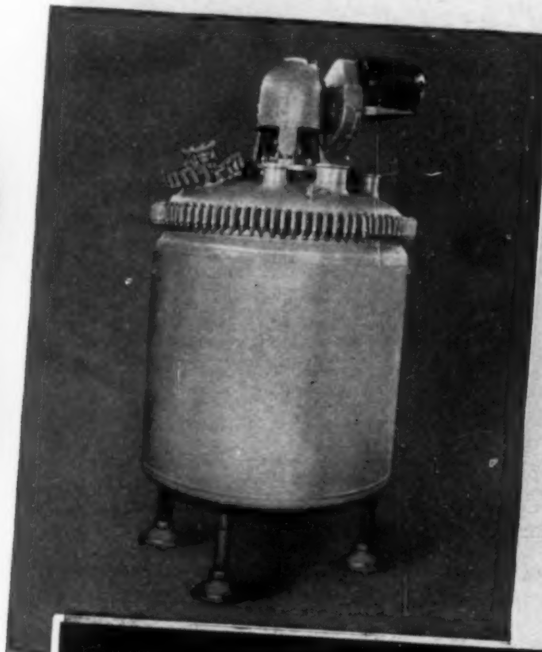
20th EXPOSITION CHEMICAL INDUSTRIES **BOOTH 655-656**

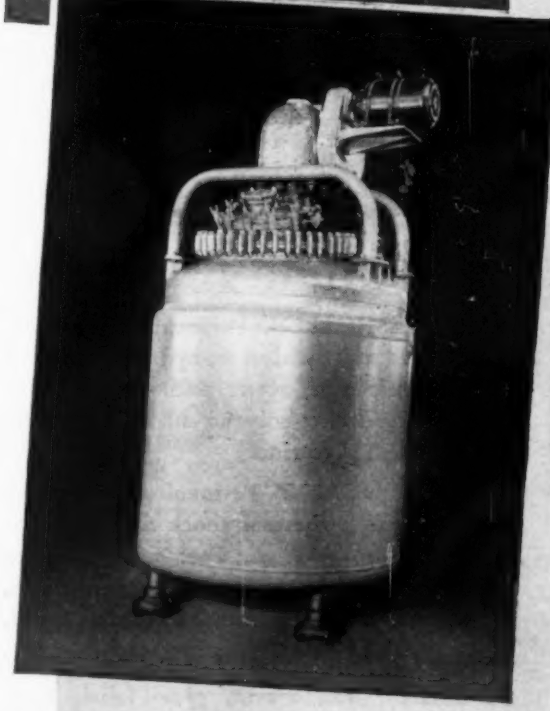
THE INERTNESS OF GLASS — THE STRENGTH OF STEEL

GLASCOTE

Corrosion Resistant

Chemical Processing Equipment





Look Us Up at the Chemical Show—
Booths 655 and 656—4th Floor

● Furnished in one piece or clamped top construction in a wide range of sizes fitted with inlets, outlets, agitators and other accessories as needed, Glascote Reaction Kettles meet industries' most exacting acid resistant requirements. The glass, developed specially for this service, is resistant to all acids at any concentration, at low or elevated temperatures, excepting hydrofluoric and hot concentrated phosphoric. Glascote glass is a true glass. It is not decomposed by heat. It is chemically inert and has all the properties of laboratory glassware combined with greater strength, toughness and elasticity.

Ask us also about glass-on-steel crystallizers, evaporators, chlorinators, condensers, distilling, mixing, storing and blending units—and our stainless steel and alloy vessels. Let Glascote engineers help you in selecting a standard or suggest special equipment to meet your particular and individual needs.

GLASCOTE PRODUCTS, *Inc.*
20901 ST. CLAIR AVENUE • CLEVELAND 17, OHIO
ENGINEERING AND SALES REPRESENTATIVES IN THE PRINCIPAL CITIES
CORROSION RESISTANT EQUIPMENT FOR THE PROCESSING INDUSTRIES

EXHIBITORS
Classified by Products
CONTINUED

ENAMELS
Atlas Powder Co. (46–47)

ENGINEERS
Artisan Metal Products Inc. (540–542)
Blaw-Knox Division of Blaw-Knox Co. 13–14)
Bowen Engineering Inc. (461B)
Eppenbach, Inc. (318)
Dorr Co. (64)
Lukens Steel Co. & Subsidiaries (558–563)
Foster D. Snell (37)
% Proportioneers, Inc. % (477–478)
Reeves Pulley Co. of N. Y., Inc (34)
Ritter Products, Division of Ritter Co. Inc. (33)
Schutte & Koerting Co. (319–320)
Stokes Machine Co., F. J. (80)

EVAPORATORS
Ace Glass Inc. (338)
Aetna Scientific Co. (262)
Aluminum Company of America (70–71)
American Smelting and Refining Co. (23)
Artisen Metal Products Inc. (540–542)
Blaw-Knox Division of Blaw-Knox Co. (13–14)
Fansteel Metallurgical Corp. (314–317)
General American Transportation Corp. (326–331)
Glascote Products, Inc. (655–656)
Koven & Bro. Inc., L. O. (248–249)
National Lead Co. (292–293)
Patterson-Kelley Co. Inc. (295)
Pfaudler Co. (72–73)
H. K. Porter Co. Inc. & Subsidiaries (256–257)
F. J. Stokes Machine Co. (80)
Swenson Evaporator Co. Division of Whiting Corp. (43)
United States Stoneware Co. (89–90)

EXHAUSTERS
DeBothezat Fans Division of American Machine & Metals, Inc. (68–69)
General Ceramics and Steatite Corp. (2)
Kewaunee Mfg. Co. (250–253)
National Lead Co. (292–293)
Schutte & Koerting Co. (319–320)
United States Stoneware Co. (89–90)

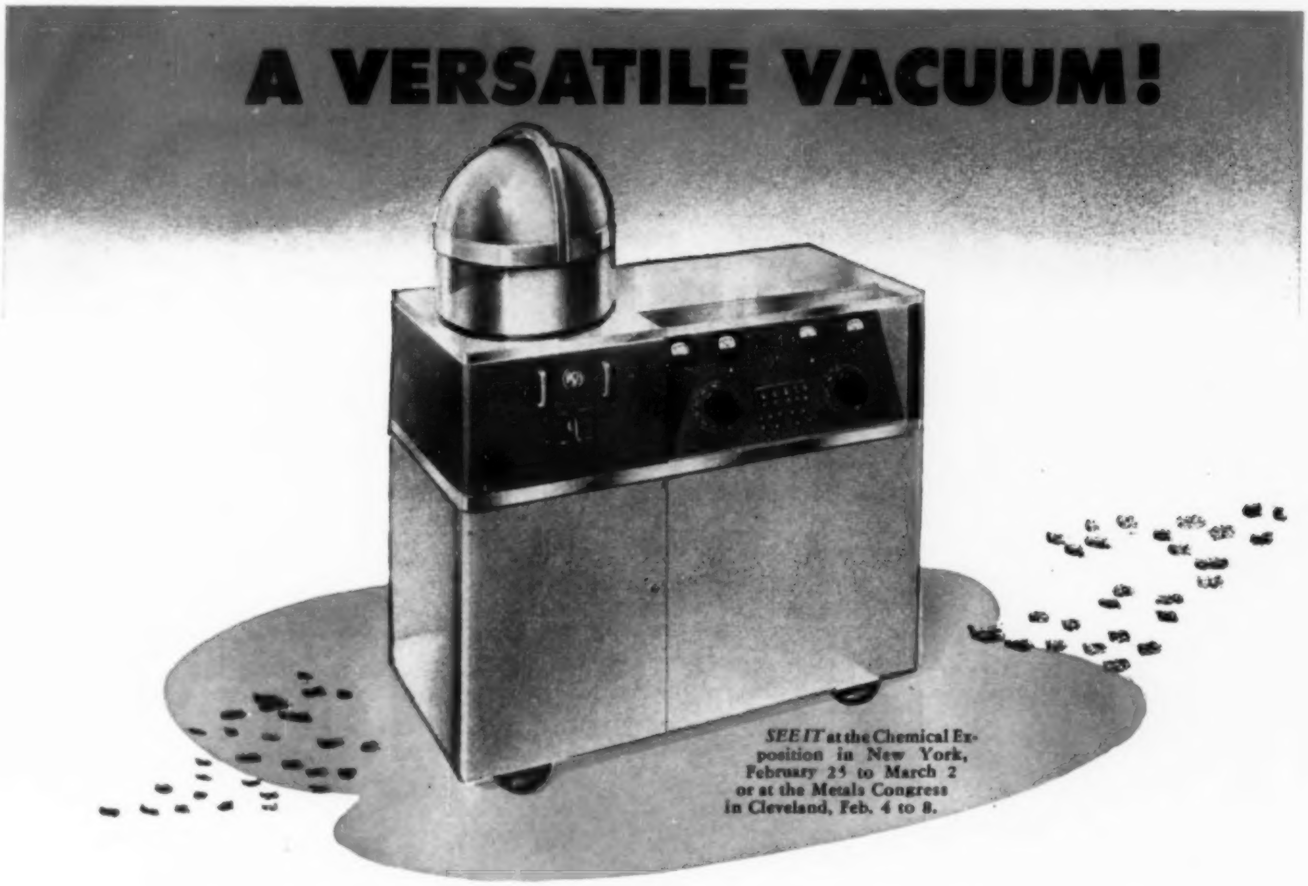
EXPLOSIVES
Atlas Powder Co. (46–47)
Hercules Powder Co. (7)

EXTRACTION PLANTS
Aluminum Company of America (70–71)
Artisan Metal Products Inc. (540–542)
Bartlett & Snow Co., C. O. (487–488)
Blaw-Knox Division of Blaw-Knox Co. (13–14)
Read Machinery Co. Inc. (308–309)
Stokes Machine Co., F. J. (80)

EXTRACTORS
Ace Glass Inc. (338)
Artisan Metal Products Inc. (540–542)
Bird Machine Co. (535–536 543–544)

(*Continued on page* 344)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.



NEW RCA VACUUM UNIT

speeds many laboratory and factory processes

Here are a few of the jobs that this new, multi-purpose RCA vacuum unit will help you do easier, quicker, and better: Mirror making; lens coating; vacuum or freeze drying; evaporating, condensing, or sputtering of materials on metal or non-metallic surfaces; and experiments where various gases at reduced pressures are required.

The RCA vacuum unit (Type EMV) consists of a vacuum chamber or bell jar, a high-speed pumping system (with simplified valving) to evacuate it, a control system, and meters and gages for reading currents, voltages, and vacuum pressures.

Within the bell jar are nine pairs of terminals.

Six of these are each capable of carrying 50 amperes. They are used to light filaments for the evaporation of metals or other materials. Any number up to six filaments can be used, and connected in series or parallel from outside the vacuum chamber. The power available for these circuits is 5 kva.

Another set of terminals is capable of carrying up to 5000 volts at 80 milliamperes—useful for ionization cleaning and for sputtering metals.

The two remaining pairs of terminals are useful in making measurements in the vacuum chamber while it is being pumped out, and for supplying power to heaters or other equipment within the bell jar.

Provision has been made so that gases, if desired, can be admitted into the vacuum chamber after the air is removed.

This vacuum unit comes equipped with two bell jars: one 18 by 18 inches, the other 18 by 29 inches (height). A vacuum of better than ½ micron (mercury) pressure is rapidly achieved in 7 or 10 minutes depending upon the size of the vacuum chamber used.

A new bulletin is now available describing many of the other features of this device which contribute to its safe, quiet, easy operation. Ask for your copy today. Write: Radio Corporation of America, Dept. 23A, Engineering Products Division, Camden, N. J.

SCIENTIFIC INSTRUMENTS

RCA

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DIVISION, CAMDEN, N. J.

EXHIBITORS
Classified by Products
CONTINUED

Blaw-Knox Division of Blaw-Knox Co. (13–14)
Fletcher Works Inc. (25)
Koven & Bro. Inc., L. O. (248–249)
Pfaudler Co. (72–73)
Porter Co. Inc., H. K. & Subsidiaries (256–257)
Read Machinery Co., Inc. (308–309)
Thomas Co., Arthur H. (665–666)
Tolhurst Centrifugal Division of American Machine & Metals Inc. (68–69)
Will Corp. (621)

FEEDERS

Bartlett & Snow Co., C. O. (487–488)
Federal Classifier Systems Inc. (404)
Fischer & Porter Co. (212–214)
Fuller Co. (263–264)
Gump Co., B. F. (205–206)
Hardinge Co. Inc. (60)
Jeffrey Mfg. Co. (44A–45)
Lapp Insulator Co. Inc. (418–419)
Niagara Filter Corp. (516–518)
Omega Machine Co. (479)
Permutit Co. (663)
% Proportioneers Inc. % (477–479)
Milton Roy Pumps (433)
Sprout, Waldron & Co. (550–553)
Syntron Co. (265–266)
Wallace & Tiernan Products Inc. (470)

FILLERS

Dicalite Co. (86)

FILLING MACHINES

Carter Engineering Co. (650)
Eppenbach Inc. (318)
Ertel Engineering Corp. (508–509)
Gump Co., B. F. (205–206)
Horix Mfg. Co. (412–413)
Karl Kiefer Machine Co. (24)
Perfektum Products Co. (215–216)
Pfaudler Co. (72–73)
Pneumatic Scale Corp. Ltd. (22)
% Proportioneers Inc. % (477–479)
Stokes Machines Co., F. J. (80)
Triangle Package Machinery Co. (564)
Will Corp. (621)

FILMS

General Aniline & Film Corp. (619–620)

FILTER AIDS

Dicalite Co. (86)
Ertel Engineering Corp. (508–509)
Hercules Filter Corp. (443–445)
Johns-Manville (93–94)
National Lead Co. (292–293)
Republic Filters, Inc. (556–557)
United States Stoneware Co. (89–90)

FILTER CLOTH

Blackburn-Smith Mfg. Co. Inc. (461A)
Eimer and Amend (57)
Ertel Engineering Corp. (508–509)
Fisher Scientific Co. (57)
Newark Wire Cloth Co. (83–84)
Owens-Corning Fiberglas Corp. (437–439)
T. Shriver & Co. Inc. (12)
Tolhurst Centrifugal Division of American Machine & Metals Inc. (68–69)
John A. Roeblings Sons Company (203–204)
Jacoby-Tarbox Corp. (540–542)

(Continued on page 346)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

"Definitely improved both quality and life of our product" . . . "Increased production 15% without added labor" . . . "Greater capacity per HP consumption" . . . "Test samples superior" . . . "We no longer have packing-gland trouble or product contamination" . . . "No internal corrugations to cause unsanitary conditions". These actual quotations are typical of performance reports from users of Premier Colloid Mills.

Whether the work to be done is emulsifying, dispersing or disintegrating . . . whether the material to be processed is liquid, paste or solid, every Premier installation proves itself by giving consistently successful results. Finer particle size is an important factor in finer products. Moreover, compulsory treatment of every particle assures uniform standards of quality. A partial list of fields which benefited from these results:—

Adhesives, sealing compounds; asphalt emulsions; ceramic colors; coating and waterproofing emulsions; cosmetics; foods and beverages; oil emulsions; inks; leather finishes; latex (synthetic and natural); lacquer emulsions; lubricating oils, greases; pigment dispersions; organic chemical dispersions; paints, lacquers, varnishes; paper coatings, fillers, waterproofing; pharmaceuticals; plastics, resins; polishes, waxes; rubber compounds; textile finishes. (Special laboratory models are available for research work.)

Where a new process is involved and performance data desired, a test run may be arranged. Premier Mill Corporation, Factory and Laboratory, Geneva, N. Y.; General Sales Offices, 110 East 42nd Street, New York 17, N. Y.

Descriptive Literature on Request

THE PREMIER MILL

Better products more profitably processed

EXHIBITORS • Classified by Products • CONTINUED

FILTER CLOTH, METALLIC
Fansteel Metallurgical Corp. (314-317)
Newark Wire Cloth Co. (83-84)
Oliver United Filters Inc. (66)
all Sweetland Metallic Filter Cloth
T. Shriver & Co. Inc. (12)
John A. Roeblings Sons Co. (203-204)
W. S. Tyler Co. (88)
Jacoby-Tarbox Corp. (540-542)

FILTER PAPER
H. Reeve Angel & Co. Inc. (340)
Eimer and Amend (57)
Ertel Engineering Corp. (508-509)
Fisher Scientific Co. (57)
Hercules Filter Corp. (443-445)
Jacoby-Tarbox Corp. (540-542)
Republic Filters, Inc. (556-557)
Shriver & Co. Inc., T. (12)
Sparkler Mfg. Co. (519)
Arthur H. Thomas Co. (665-666)
Welch Mfg. Co. W. M. (405)
Will Corp. (621)

FILTERS
Ace Glass Incorporated (338)
Alsop Engineering Co. (321-322)
American Air Filter Co. Inc. (489-491)
American Foundry Equipment Co. (481-484)
Bird Machine Co. (535-536 543-544)
Blackburn-Smith Mfg. Co. Inc. (461A)
Bramley Machine Corp. (520-521)
Carborundum Co. (91)
Centrifuge Mechanical Equipment Inc. (671)
Ertel Engineering Corp. (508-509)
Filtration Engineers Inc. (8)
General American Transportation Corp. (326-331)
General Ceramics and Steatite Corp. (2)
Hardings Co. Inc. (60)
Haveg Corp. (51)
Karl Kiefer Machine Co. (24)
Knight, Maurice A. (53)
Metal-Glass Products Co. (425-426)
National Carbon Co. Inc. (30-31)
Niagara Filter Corp. (516-518)
Norton Co. (415-417)
Oliver United Filters Inc. (66)
Owens-Corning Fiberglas Corp. (437-439)
Permutit Co. (663)
Republic Filters Inc. (556-557)
Selas Corp. of America (533-534)
Shriver & Co. Inc., T. (12)
Sparkler Mfg. Co. (519)
Sperry & Co., D. R. (540-542)
Swenson Evaporator Co. Division of Whiting Corp. (43)
Tri-Clover Machine Co. (567-568)
United States Stoneware Co. (89-90)

FIRE DETECTION
Davis Emergency Equipment Co. Inc. (679)
Kidde & Co., Walter (423)

FIRE EXTINGUISHERS
Davis Emergency Equipment Co. Inc. (679)
Kidde & Co., Walter. (423)
Will Corp. (621)

FIRE PROOFING COMPOUNDS
Amecco Chemicals, Inc. (648-649)
Glyco Products Co. Inc. (223-224)
Hercules Powder Co. (7)
Munn & Steele, Inc. (648-649)

FITTINGS
American Hard Rubber Co. (269-270)
American Instrument Co. (334-335)
American Smelting and Refining Co. (23)
Crane Co. (312-313)
Duriron Co. Inc. (19-20)
General Ceramics and Steatite Corp. (2)
Glascote Products, Inc. (655-666)
Globe Steel Tube Co. (537-538)
Hasco Valve & Machine Co. (641)
National Carbon Co. Inc. (30-31)
National Lead Co. (292-293)
Pfaudler Co. (72-73)
Schutte & Koerting Co. (319-320)
Tri-Clover Machine Co. (567-568)

FLOORING
Blaw-Knox Division of Blaw-Knox Co. (13-14)
Johns-Manville (93-94)
United States Stoneware Co. (89-90)

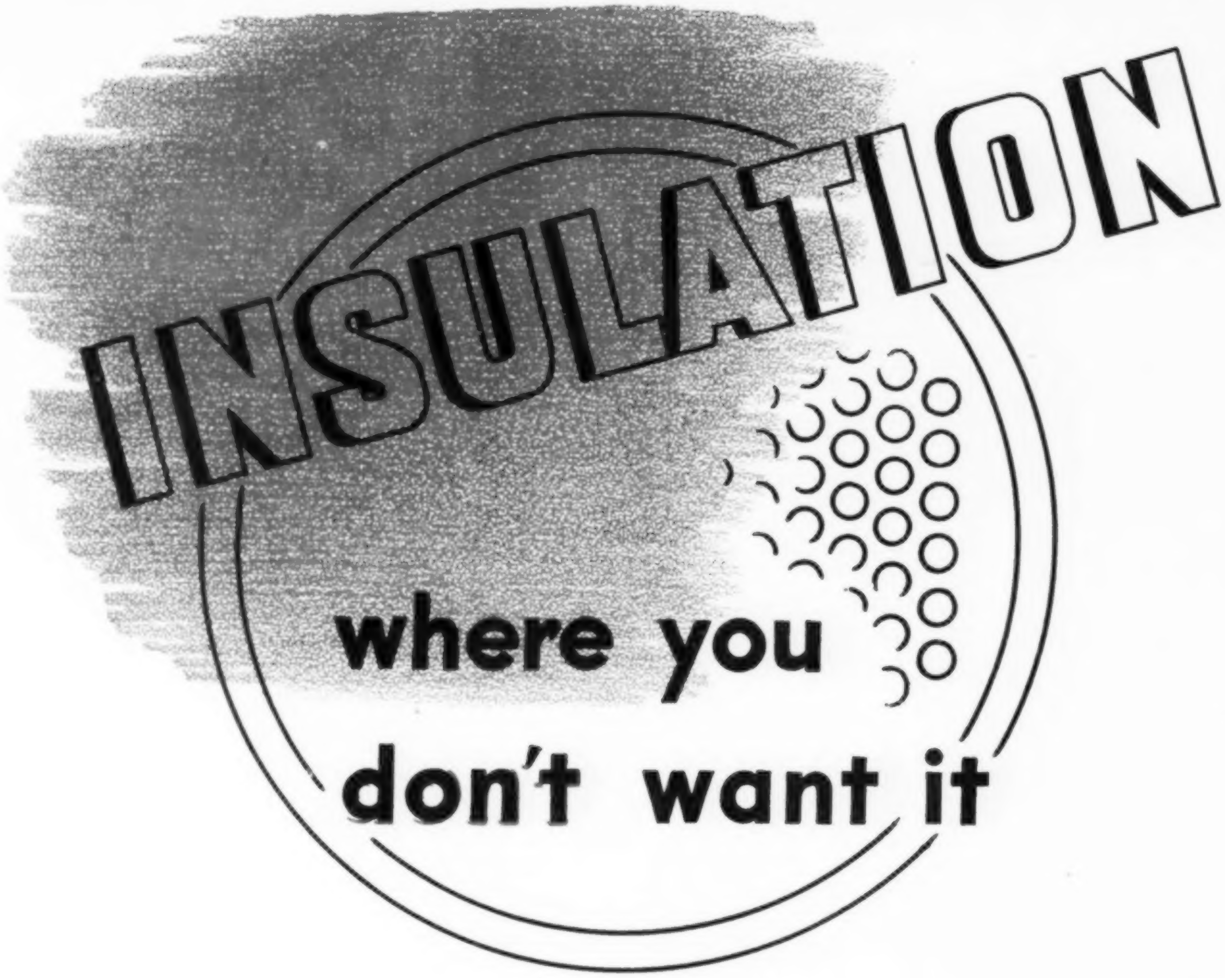
FLOTATION MACHINES
Denver Equipment Co. (507)

FLUXES
American Platinum Works (456)
Eutectic Welding Alloys Co. (462-464)

FOOD INDUSTRIES EQUIPMENT
Aetna Scientific Co. (262)
Alloy Steel Products Co. (651-652)
Aluminum Company of America (70-71)
American Hard Rubber Co. (269-270)
Artisan Metal Products Inc. (540-542)
Baker Perkins Inc. (62-63)
Bowen Engineering Inc. (461B)
Bramley Machinery Corp. (520-521)
Cayne, Albert H. (638-640)
Corning Glass Works (332-333 346-347)
Dorr Co. (64)
Eppenbach, Inc. (318)
Eriez Mfg. Co. (632)
Fischer & Porter Co. (212-214)
Fitzpatrick Co. Inc., W. J. (401-402)
Glascote Products, Inc. (655-656)
Gump Co., B. F. (205-206)
Hercules Filter Corp. (443-445)
Horix Mfg. Co. (412-413)
Illinois Electric Porcelain Co. (672-673)
Kewaunee Mfg. Co. (250-253)
Karl Kiefer Machine Co. (24)
Lapp Insulator Co. Inc. (418-419)
Luzerne Rubber Co. (528-529)
Metal-Glass Products Co. (425-426)
Mixing Equipment Co. Inc. (273-274)
National Engineering Co. (554-555)
New Jersey Machine Corp. (485-486)
Niagara Blower Co. (493-495)
Omega Machine Co. (479)
Pfaudler Co. (72-73)
Porter Co. Inc., H. K. & Subsidiaries (256-257)
Pressed Steel Tank Co. (280-282)
Proctor & Schwartz Inc. (15)
Productive Equipment Corp. (549)
% Proportioneers, Inc. % (477-479)
Pulverizing Machinery Co. (246-247)
Read Machinery Co. Inc. (308-309)
Republic Filters Inc. (556-557)
Richmond Mfg. Co. (441)
Sprout, Waldron & Co. (550-553)
Stokes Machine Co., F. J. (80)
Tri-Clover Machine Co. (567-568)
Tyler Co., W. S. (88)
Wallace & Tiernan Products Inc. (470)

(*Continued on page* 348)

Compiled from information supplied to National Chemical Exposition.
No responsibility assumed for errors or omissions.



● Insulation where you don't want it — and worse yet, where you can't see it — in the form of slime deposits on heat transfer surfaces, may be actually costing you thousands of dollars annually. A slime coating — even a film that's barely visible — will insulate condensers so they cannot function at rated capacity. And that may raise your production costs disastrously.

Mechanical cleaning is not the answer. Not only is it a slow, laborious process, but it's costly to take condensers "off the line" periodically for this outmoded method of cleaning.

That is the reason so many plants are employing W&T Chlorination. Slime deposits already present are removed without shutdowns and their recurrence prevented, insuring a continuously slime-free cooling system.

Wallace & Tiernan chlorinating equipment is engineered to meet the specific needs of each individual plant, and W&T engineers will gladly recommend the most practical method of chlorine application for slime control in *your* plant.

WALLACE & TIERNAN
PRODUCTS, INC.

Manufacturers of Chlorine and Ammonia Control Apparatus
Belleville 9, New Jersey • Represented in Principal Cities

CD-20

EXHIBITORS
Classified by Products
CONTINUED

FURNACES AND ACCESSORIES
American Instrument Co. (334-335)
Baker & Co. (451-452)
Eclipse Fuel Engineering Co. (500)
Fischer & Porter Co. (212-214)
General Alloys Co. (299)
Thomas Co., Arthur H. (665-666)
Trent Co., Harold E. (573)
Will Corp. (621)

GAGES
Ace Glass Inc. (338)
American Instrument Co. (334-335)
Fischer & Porter Co. (212-214)
Meriam Instrument Co. (514)
Powell Co., Wm. (54)
Stokes Machine Co., F. J. (80)
Welch Mfg. Co., W. M. (405)

GAS ABSORBERS
Eppenbach, Inc. (318)

GAS ANALYSIS APPARATUS
Davis Emergency Equipment Co. Inc. (679)
Mine Safety Appliances Co. (210A-310B-210C)

GAS BOOSTERS
Eclipse Fuel Engineering Co. (500)

GAS PRODUCERS
Koven & Bro. Inc., L. O. (248-249)

GAS PURIFIERS
Baker & Co. Inc. (451-452)
Blaw-Knox Division Of Blaw-Knox Co. (13-14)
Koven & Bro. Inc., L. O. (248-249)
Lithaloys Corp. (667-668)

GASES
Ansul Chemical Co. (82)
Lithaloys Corp. (667-668)
Matheson Co. Inc. (305)
Phillips Petroleum Company (633-634)

GEARS
Cleveland Worm & Gear Co. (502-503)
Farval Corp. (502-503)
Lukens Steel Company & Subsidiaries (558-563)
Philadelphia Gear Works (78)
Patron Transmission Co. (617 & 643)

GLASS CUTTING-OFF MACHINERY
American Instrument Co. (334-335)

GLASS—OPTICAL
American Instrument Co. (334-335)
Will Corp. (621)

GLASSWARE
Ace Glass Incorporated (338)
Corning Glass Works (332-333 346-347)
Eimer and Amend (57)
Fischer & Porter Co. (212-214)
Fisher Scientific Co. (57)
Kimble Glass Co. (342-343)
Scientific Glass Apparatus Co. (218-220)
Standard Scientific Supply Corp. (618)
Thomas Co., Arthur H. (665-666)
Welch Mfg. Co., W. M. (405)
Will Corp. (621)

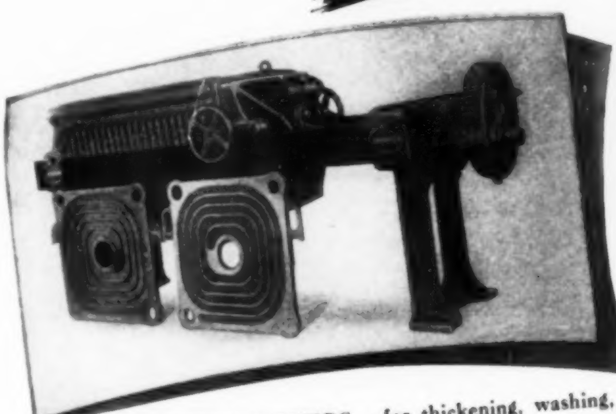
(*Continued on page* 350)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

20th EXPOSITION CHEMICAL INDUSTRIES BOOTH 12

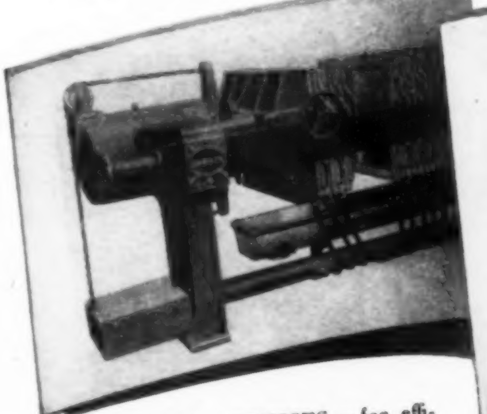
ANTICIPATING TOMORROW'S NEEDS

FOR NEW PROCESSES IMPROVED TECHNIQUES



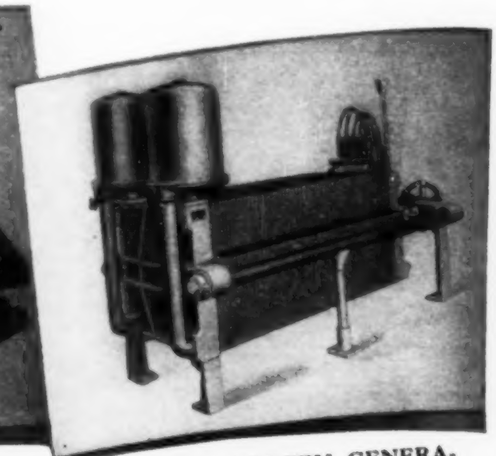
CONTINUOUS THICKENERS — for thickening, washing, extracting of slow settling or difficult materials at a faster rate and lower cost than in settling tanks; high thickening rate saves processing time, space and equipment; built of metal, wood or rubber for specific capacity requirements.

FILTER PRESSES—the "old faithfuls" in chemical processing —in step with modern design and applications; built of any metal, wood or rubber for operation at any temperature, pressure, flow rate and capacity; for efficient cake recovery, washing and drying or clarification, purifying and decolorizing; available as stationary or portable units.



WAX MOLDING PRESSES — for efficient molding of wax into cakes of uniform size, weight and appearance. Presses built with any number of molding frames and for any size of cakes. Wax is cooled by cold water circulating in the hollow baffled plates on each side of the frames.

DIAPHRAGM PUMPS — for corrosive, abrasive, thick, viscous, heavy, delicate or hazardous materials. Double acting piston, positive displacement type; fluid handled does not contact working parts. Liquid end built of any metal or rubber covered. Pressure to 100 p.s.i. No packings or leakage.



OXYGEN-HYDROGEN GENERATORS — for producing gases of high purity at maximum efficiency in quantities of 5 to 110 cubic feet of oxygen and 10 to 220 cubic feet of hydrogen per hour. Simple in design and operaper hour. Simple in design and operation; complete, compact, rugged, minimum space and attention.

Functional improvements and new designs in Shriver Equipment offer to the process industries, better performance standards and greater operating economy.

You can look to Shriver to help you solve your processing problems. Write for catalogs.

SHRIVER

Visit Booth No. 12 at the Chemical Exposition

T. SHRIVER & COMPANY, Inc. • 802 Hamilton St. Harrison, N. J.

EXHIBITORS • Classified by Products • CONTINUED

GRATING
Blaw-Knox Division of Blaw-Knox Co. (13–14)

GRINDERS
Eppenbach, Inc. (318)
Gump Co., B. F. (205–206)
Jay Bee Sales Co. (209)
Raymond Pulverizer Division of Combustion Engineering Co. (67)
Sprout, Waldron & Co. (550–553)
Will Corp. (621)

HEAT EXCHANGERS
Ace Glass Incorporated (338)
Aetna Scientific Co. (262)
Aluminum Company of America (70–71)
Artisan Metal Products Inc. (540–542)
Blaw-Knox Division of Blaw-Knox Co. (13–14)
Blickman Inc., S. (474–475)
Corning Glass Works (332–333 346–347)
Duriron Co. Inc. 19–20)
Fansteel Metallurgical Corp. (314–317)
General Ceramics & Steatite Corp. (2)
Glascote Products, Inc. (655–656)
Heil Engineering Co. (575)
Koven & Bro. Inc., L. O. (248–249)
National Carbon Co. Inc. (30–31)
National Lead Co. (292–293)
Niagara Blower Co. (493–495)
Patterson-Kelley Co. Inc. (295)
Pfaudler Co. (72–73)
Porter Co. Inc., H. K. & Subsidiaries (256–257)
Pressed Steel Tank Co. (280–282)
Schutte & Koerting Co. (319–320)
Tenney Engineering Inc. (678)
United States Steel Corp. (76–77)
Walker-Wallace Inc. (572)

HEATING SYSTEMS AND ACCESSORIES
Eimer and Amend (57)
Grinnell Co. Inc. (290–291)
Munn & Steele Inc. (569)
Sarco Co. Inc. (11)

HEATERS AND HEATING EQUIPMENT
American Instrument Co. (334–335)
Eclipse Fuel Engineering Co. (500)
Eimer and Amend (57)
Fansteel Metallurgical Corp. (314–317)
Fisher Scientific Co. (57)
Koven & Bro. Inc., L. O. (248–249)
Niagara Blower Co. (493–495)
Patterson-Kelley Co. Inc. (295)
Schutte & Koerting Co. (319–320)
Selas Corp. of America (533–534)
Trent Co., Harold E. (573)
United States Steel Corp. (76–77)
Will Corp. (621)

HOISTS
Barrett-Cravens Co. (232–233)
Bartlett & Snow Co., C. O. (487–488)
Cayne, Albert H. (638–640)

HOMOGENIZERS
American Smelting and Refining Co. (23)
Bramley Machinery Corp. (520–521
Eppenbach, Inc. (318)
Fitzpatrick Co. Inc., W. J. (401–402)
Marco Co. Inc. (646–647)
Will Corp. (621)

HOODS
Alberene Stone Corp of Virginia (79)
American Smelting and Refining Co. (23)
DeBothezat Fans Division of American Machine & Metals Inc. (68–69)
Haveg Corp. (51)
Kewaunee Mfg. Co. (250–253)
Koven & Bro. Inc., L. O. (248–249)
Laboratory Furniture Co. Inc. (221–222)
Metalab Equipment Corp. (504)
Peterson & Co. Inc., Leonard (442)
Sheldon & Co., E. H. (288–289)
Stanley Co., A. B. (624)
United States Stoneware Co. (89–90)

HUMECTANT
Atlas Powder Co. (46–47)

HUMIDIFYING APPARATUS
Air & Refrigeration Corp. (459–460)
American Instrument Co. (334–335)
Electric Hotpack Co. Inc. (642)
Niagara Blower Co. (493–495)
Tenney Engineering Inc. (678)

HYDROGENATION APPARATUS
American Instrument Co. (334–335)

IMPREGNATING APPARATUS
F. J. Stokes Machine Co. (80)

INDICATORS
Cayne, Albert H. (638–640)
Davis Emergency Equipment Co. Inc. (679)
Eimer & Amend (57)
Exact Weight Scale Company (476)
Fischer & Porter Company (212 to 214)
Fisher Scientific Co. (57)
Illinois Testing Laboratories, Inc. (38)
Jacoby-Tarbox Corp. (540–542)
Macbeth Corporation (400)
Omega Machine Co. (479)
Schutte & Koerting Company (319)

INJECTORS
Schutte & Koerting Company (319)

INSTRUMENT PANELS
Falstrom Company (519–520)

INSTRUMENTS—OPTICAL
American Instrument Company (334–335)
Eimer & Amend (57)
Fischer & Porter Co. (212–214)
Fisher Scientific Co. (57)
Gamma Instrument Company, Inc. (497)
Pike & Co., E. W. (408)
Thomas Co., Arthur H. (665–666)
Will Corp. (621)

INSTRUMENTS—PRECISION
American Instrument Company (334–335)
Baker & Co. Inc. (451–452)
Cambridge Instrument Company (271–272)
Englehard, Inc., Charles (455)
Fischer & Porter Company (212 to 214)
Illinois Testing Laboratories, Inc. (38)

(*Continued on page* 352)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

EXHIBITORS
Classified by Products
CONTINUED

North American Philips Co. Inc. (574)
% Proportioneers, Inc. % (477 to 479)
Schutte & Koerting Company (319–320)
Scientific Glass Apparatus Co. (218 to 220)
Superior Electric Co. (522–523)
Thomas Co., Arthur H. (665–666)
Wallace & Tiernan Products Co. (470)
Will Corp. (621)

INSTRUMENTS—TESTING

American Instrument Company (334–335)
Barnstead Still and Sterilizer Co. Inc. (225–226)
Brabender Corp. (287)
Coleman Electric Company (339 and A)
Davis Emergency Equipment Co. Inc. (679)
Eimer and Amend (57)
Fischer & Porter Company (212 to 214)
Fisher Scientific Co. (57)
Gamma Instrument Company, Inc. (497)
Illinois Testing Laboratories, Inc. (38)
Industrial Instruments, Inc. (410)
Macbeth Corporation (400) pH
Meriam Instrument Company (514)
National Technical Laboratories (300 to 302)
Newark Wire Cloth Company (83–84)
North American Philips Co. Inc. (574)
Permutit Company (663)
Photovolt Corporation (285)
Picker X-Ray Corporation (492)
Scientific Glass Apparatus Co. (218 to 220)
Taylor & Company, W. A. (337)
Thomas Co., Arthur H. (665–666)
Wallace & Tiernan Products, Inc. (47)
W. M. Welch Mfg. Co. (405)
Will Corp. (621)
Willson Products, Inc. (431–432)

INSULATING MATERIAL—HEATING, ELECTRIC AND MOLDED

American Hard Rubber Company (269–270)
Amersil Company, Inc. (454)
Dicalite Company (86)
Haveg Corp. (51)
Illinois Electric Porcelain Company (672–673)
Luzerne Rubber Co. (528–529)
Munn & Steele, Inc. (569)
Owens-Corning Fiberglas Corp. (437 to 439)

INSULATION—FURNACE

Carborundum Company (91)
Dicalite Company (86)
General Ceramics & Steatite Corporation (2)
Johns-Manville (93–94)
Munn & Steele, Inc. (569)
Scientific Glass Apparatus Co. (218 to 220)
U. S. Stoneware Co. (89–90)

(*Continued on page 354*)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

SEAMLESS CONSTRUCTION GIVES THEM THAT AMAZING STRENGTH

For strength that is rugged and durable . . . look to Hackney Cylinders. Seamless construction makes them that way. A deep-drawn seamless shell is formed by cupping and cold-drawing. The open end is then completely closed, and the neck is formed by the special Hackney Process of hot spinning which assures an extremely even flow of the metal.

This method of construction not only assures a strong cylinder but a lightweight one as well. By eliminating all excess weight, Pressed Steel Tank Company provides a cylinder that makes possible an important reduction in shipping costs. Write today for full details.

Hackney

Pressed Steel Tank Company

Manufacturers of Hackney Products

1447 South 66th Street, Milwaukee 14, Wisconsin
1325 Vanderbilt Concourse Building, New York 17 208 South LaSalle St., Room 2070, Chicago 4
553 Roosevelt Building, Los Angeles 14

CONTAINERS FOR GASES, LIQUIDS AND SOLIDS

EXHIBITORS
Classified by Products
CONTINUED

KETTLES

Aluminum Company of America (70–71)
Artisan Metal Products Inc. (540–542)
Duriron Company, Inc. (19–20)
Glascote Products, Inc. (655–656)
Haveg Corp. (51)
Knight, Maurice A. (53)
Koven & Bro., Inc., L. O. (248–249)
National Lead Co. (292–293)
Patterson-Kelley Co. Inc. (295)
Pfaudler Company (72–73)
Read Machinery Co. Inc. (308–309)
Selas Corporation of America (533–534)
Trent Company, Harold E. (573)

KILNS

Bartlett & Snow Co., C. O. (487–488)
Electric Hotpack Company, Inc. (642)
General American Transportation Corp. (326–331)
Hardinge Company, Inc. (60)
Selas Corporation of America (533–534)
Trent Company, Harold E. (573)

LABELING MACHINES

Economic Machinery Company (545–546)
New Jersey Machine Corp. (485–486)
Pneumatic Scale Corp. Ltd. (22)
Tripard Mfg. Co. (411)

LABORATORIES—TESTING

Ace Glass, Inc. (338)
Dorr Company (64)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Newark Wire Cloth Co. (83–84)
Ritter Products, Division of Ritter Co. Inc. (33)
Scientific Glass Apparatus Co. (218–220)
Snell Inc., Foster D. (37)
Tenney Engineering, Inc. (678)

LABORATORY APPARATUS AND SUPPLIES

Ace Glass, Inc. (338)
American Hard Rubber Company (269–270)
American Instrument Co. (334–335)
American Platinum Works (456)
Amersil Co. Inc. (454)
Aetna Scientific Co. (262)
Barnstead Still & Sterlizer Co. Inc. (225–226)
Baker & Co. (451–452)
Bowen Engineering Inc. (461B)
Brabender Corp. (267)
Coleman Electric Co. (339 and A)
Eimer & Amend (57)
Electric Hotpack Co. Inc. (642)
Ertel Engineering Corp. (508–509)
Eppenbach, Inc. (318)
Federal Classifier Systems Inc. (404)
Fischer & Porter Co. (212–214)
Fisher Scientific Co. (57)
Fletcher Works, Inc. (25)
Glascote Products Inc. (655–656)
Hanovia Chemical & Mfg. Co. (457–458)
Hercules Filter Corp. (443–445)
Hoke Inc. (217)
Kimble Glass Co. (342–343)

(*Continued on page* 356)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

EXHIBITORS
Classified by Products
CONTINUED

Luzerne Rubber Co. (528–529)
Meriam Instrument Co. (514)
Mixing Equipment Co. Inc. (273–274)
National Technical Laboratories (300–302)
Norton Co. (415–417)
Pulverizing Machinery Co. (246–247)
Republic Filters Inc. (556–557)
Richmond Mfg. Co. (441)
Scientific Glass Apparatus Co. (218–220)
Selas Corporation of America (533–534)
Sharples Corp. (58–59)
Standard Scientific Supply Corp. (618)
Tolhurst Centrifugals Div. American Machine & Metals Inc. (68–69)
Trent Co., Harold E. (573)
Tyler Co., W. S. (88)
United States Stoneware Co. (89–90)
Welch Mfg. Co., W. M. (405)
Will Corp. (621)

LACQUERS
American Resinous Chemicals Corp. (35–36)
Atlas Powder Co. (46–47)
Dow Chemical Co. (227–230)
Hercules Powder Co. (W pt 7)
United States Stoneware Co. (89–90)

LAMPS
Hanovia Chemical & Mfg. Co. (457–458)
Macbeth Corp. (400)
Will Corp. (621)

LABORATORY FURNITURE
Alberene Stone Corp. of Virginia (79)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Hamilton Mfg. Co. (244–245)
Kewaunee Mfg. Co. (250–253)
Laboratory Furniture Co. Inc. (221–222)
Metalab Equipment Corp. (504)
Peterson & Co. Inc. Leonard (442)
Scientific Glass Apparatus Co. (218–220)
Sheldon & Co., E. H. (288–289)
Sjostrom Co., John E. (664)
Sherburne Co. (644–645)
Stanley Co., A. B. (624)
Welch Mfg. Co., W. M. (405)

LEAD BURNING AND COATING
American Smelting & Refining Co. (23)
Heil Engineering Co. (575)
National Lead Co. (292–293)
U. S. Stoneware Co. (89–90)

LIME CHEMICAL AND HYDRATED
Dow Chemical Co. (227–230)

LINERS
Janney Cylinder Company (286)

LOADERS
Albert H. Cayne (638–640)
Rapids-Standard Company, Inc. (446–450)

(*Continued on page* 358)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

BECAUSE ALL STRANDS ARE STRONGLY LATTICE-LINKED TOGETHER!

PATENTED

The unique structural design of Garlock LATTICE-BRAID holds the strands together even when the packing is worn far beyond the serviceable limits of wear of ordinary braided packings.

This same "lattice" braiding provides unusual flexibility and semi-automatic pressure action.

Garlock LATTICE-BRAID packing is furnished in several styles for various types of service. Write for illustrated descriptive folder.

Garlock 731 Lattice-Braid Coil

GARLOCK

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

EXHIBITORS • Classified by Products • CONTINUED

LUBRICATING SYSTEMS AND LUBRICATORS
Cleveland Worm & Gear Co. (502–503)
Farval Corporation (502–503)

MAGNETIC SEPARATORS
Eriez Manufacturing Co. (632)
Richmond Mfg. Co. (441)
Sprout, Waldron & Co. (550 to 553)

MANOMETERS
Meriam Instrument Co. (514)

MASTICATORS
Bramley Machinery Corporation (520–521)

MATERIALS HANDLING EQUIPMENT
Barrett-Cravens Co. (232–233)
Bartlett & Snow Co., C. O. (487–488)
Cayne, Albert H. (638 to 640)
Dorr Company (64)
Eppenbach, Inc. (318)
Eriez Manufacturing Co. (632)
Falstrom Company (519–520)
Fuller Company (263–264)
Gump Company, B. F. (205–206)
Horix Manufacturing Co. (412–413)
Hyster Company (613–614)
Industrial Products Company (611)
Island Equipment Corp. (635)
Lever Company, Geo. C. (605)
Lewis-Shepard Products Inc. (277 to 279)
Luzerne Rubber Co. (528–529)
Metzgar Company (606)
Moto-Truc Company (603–604)
National Engineering Co. (554–555)
Patron Transmission Co. (617 & 643)
Reeves Pulley Co. of N. Y. Inc. (34)
Rapids-Standard Company, Inc. (446 to 450)
Read Machinery Co. Inc. (308–309)
Sherburne Co. (644–645)
Sprout, Waldron & Co. (550 to 553)
Syntron Company (265–266)
U. S. Stoneware Co. (89–90)
Wright-Hibbard Industrial Electric Truck Co. Inc. (607 to 610)

METAL COATING AND PLATING
American Resinous Chemicals Corp. (35–36)
Bareco Oil Company (629–630)
Hercules Powder Co. (W pt 7)
International Nickel Company, Inc. (9)
National Lead Co. (292–293)
U. S. Stoneware Co. (89–90)

METAL CONTAINERS
Aluminum Company of America (70–71)
Blickman, Inc., S. (474–475)
Falstrom Company (510–511)
International Nickel Company, Inc. (9)
Koven & Bro., Inc., L. O. (248–249)
Makepeace Company, D. E. (453)
National Lead Co. (292–293)
Pressed Steel Tank Co. (280 to 282)
Republic Steel Corporation (434 to 436)

METALS
Allegheny Ludlum Steel Corp. (296–298)
Aluminum Company of America (70–71)
American Platinum Works (456)
American Smelting & Refining Co. (23)
Falstrom Company (510–511)
Fansteel Metallurgical Corp. (314 to 317)
Hanovia Chemical & Mfg. Company (457–458)
International Nickel Company, Inc. (9)
Hills-McCanna Company (260–261)
Janney Cylinder Company (286)
Lithaloys Corporation (667–668)
Lukens Steel Company and Subs. (558 to 563)
National Lead Company (292–293)
Makepeace Company, D. E. (453)
Pressed Steel Tank Co. (280 to 282)
Republic Steel Corporation (667–668)
Sivyer Steel Casting Company (512–513)
Titanium Alloy Manufacturing Co. (207–208)
United States Steel Corp. (76–77)

METERS
American Meter Company (39 to 41)
Barnstead Still & Sterilizer Co. Inc. (225–226)
Coleman Electric Company (339 and A)
Fischer & Porter Company (212 to 214)
Hanovia Chemical & Mfg. Company (457–458)
Illinois Testing Laboratories, Inc. (38)
Macbeth Corporation (400)
Meriam Instrument Co. (514)
% Proportioneers, Inc. % (477 to 479)
Selas Corporation of America (533–534)
Wallace & Tiernan Products, Inc. (470)
Welch Mfg. Co., W. M. (405)

MICROSCOPES
American Instrument Company (334–335)
Eimer & Amend (57)
Fisher Scientific Co. (57)
Pike & Co., E. W. (406)
Standard Scientific Supply Corp. (618)
Thomas Co., Arthur H. (665–666)
W. M. Welch Mfg. Co. (405)

MILLS
Eppenbach, Inc. (318)
Gump Company, B. F. (205–206)
Hardinge Company, Inc. (60)
Jay Bee Sales Company (209)
Porter Company, Inc., H. K. (256–257)
Pulverizing Machinery Co. (246–247)
Raymond Pulverizer Div. Combustion Engineering Co. (67)
Thomas Co., Arthur H. (665–666)
U. S. Stoneware Co. (89–90)

MINERALS
Munn & Steele, Inc. (569)

MIXING AND KNEADING MACHINERY
Alsop Engineering Co. (321–322)
Baker Perkins, Inc. (62–63)
Bramley Machinery Corporation (520–521)
Centrifuge Mechanical Equipment, Inc. (671)
Eppenbach, Inc. (318)
General American Transportation Corp. (326–331)
Glascote Products, Inc. (655–656)

(Continued on page 360)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

EXHIBITORS
Classified by Products
CONTINUED

Gump Company, B. F. (205–206)
Fitzpatrick Company, Inc., W. J. (401–402)
Mixing Equipment Co. Inc. (273–274)
National Engineering Company (554–555)
New England Tank & Tower Co. (50)
Porter Company, Inc., H. K. (256–257)
Read Machinery Co. Inc. (308–309)
Schutte & Koerting Company (319–320)
Sprout, Waldron & Co. (550 to 553)
Worthington Pump & Machinery Corp. (267–268)

MOLDING MACHINERY

Hydraulic Press Mfg. Company (602)
Stokes Machine Co., F. J. (80)
Trent Company, Harold E. (573)

MOTORS—ELECTRIC

Patron Transmission Co. (617 & 643)
Reeves Pulley Co. of N. Y. Inc. (34)

NAVAL STORES

Hercules Powder Co. (W pt 7)

NITRATORS

General Ceramics & Steatite Corp. (2)
Glascote Products, Inc. (655–656)
Porter Company, Inc., H. K. (256–257)
Tolhurst Centrifugals Div.
American Machine & Metals, Inc. (68–69)

NOZZLES—SPRAY

Ace Glass, Inc. (338)
Duriron Company, Inc. (19–20)
Luzerne Rubber Co. (528–529)
Monarch Manufacturing Works, Inc. (201)
National Carbon Co. Inc. (30–31)
Norton Co. (415–417)
Schutte & Koerting Company (319–320)

OVENS—ELECTRIC—LABORATORY

Aetna Scientific Co. (262)
American Instrument Company (334–335)
Eimer & Amend (57)
Electric Hotpack Company, Inc. (642)
Fisher Scientific Co. (57)
Metalab Equipment Corp. (504)
Scientific Glass Apparatus Co. (218 to 220)
Standard Scientific Supply Corp. (618)
Tenney Engineering, Inc. (678)
Thomas Co., Arthur H. (665–666)
Trent Company, Harold E. (573)
Will Corp. (621)

OVENS—INDUSTRIAL

Selas Corporation of America (533–534)
Trent Company, Harold E. (573)

PACKING

Garlock Packing Company (323–324)
Johns-Manville (93–94)
Marlo Company (530)
Owens-Corning Fiberglas Corp. (437 to 439)

(*Continued on page* 361)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

EXHIBITORS
Classified by Products
CONTINUED

PACKAGING EQUIPMENT AND SUPPLIES

Acme Steel Company (427–428)
Carpenter Container Corporation (239)
Carter Engineering Co. (650)
Bemis Bro. Bag Co. (275–276)
Gump Company, B. F. (205–206)
Kiefer Machine Co., Karl (24)
New Jersey Machine Corp. (485–486)
Pneumatic Scale Corp. Ltd. (22)
Reeves Pulley Co. of N. Y. Inc. (34)
Sherburne Co. (644–645)
St. Regis Paper Company (531–532)
Triangle Package Machinery Co. (564)
Tripard Manufacturing Co. Inc. (411)

PAPER MACHINERY

Bird Machine Co. (535–536—543–544)
Eriez Manufacturing Co. (632)
Hercules Filter Corporation (443 to 445)
Hills McCanna Co. (260–261)
Lukens Steel Company and Subs. (558 to 563)
Paper and Industrial Appliances, Inc. (472–473)
Swenson Evaporator Company Div. Whiting Corp. (43)

PERFORATED METALS

American Platinum Works (456)
American Smelting and Refining Co. (23)

PETROLEUM PRODUCTS

Phillips Petroleum Co. (633–634)

pH EQUIPMENT

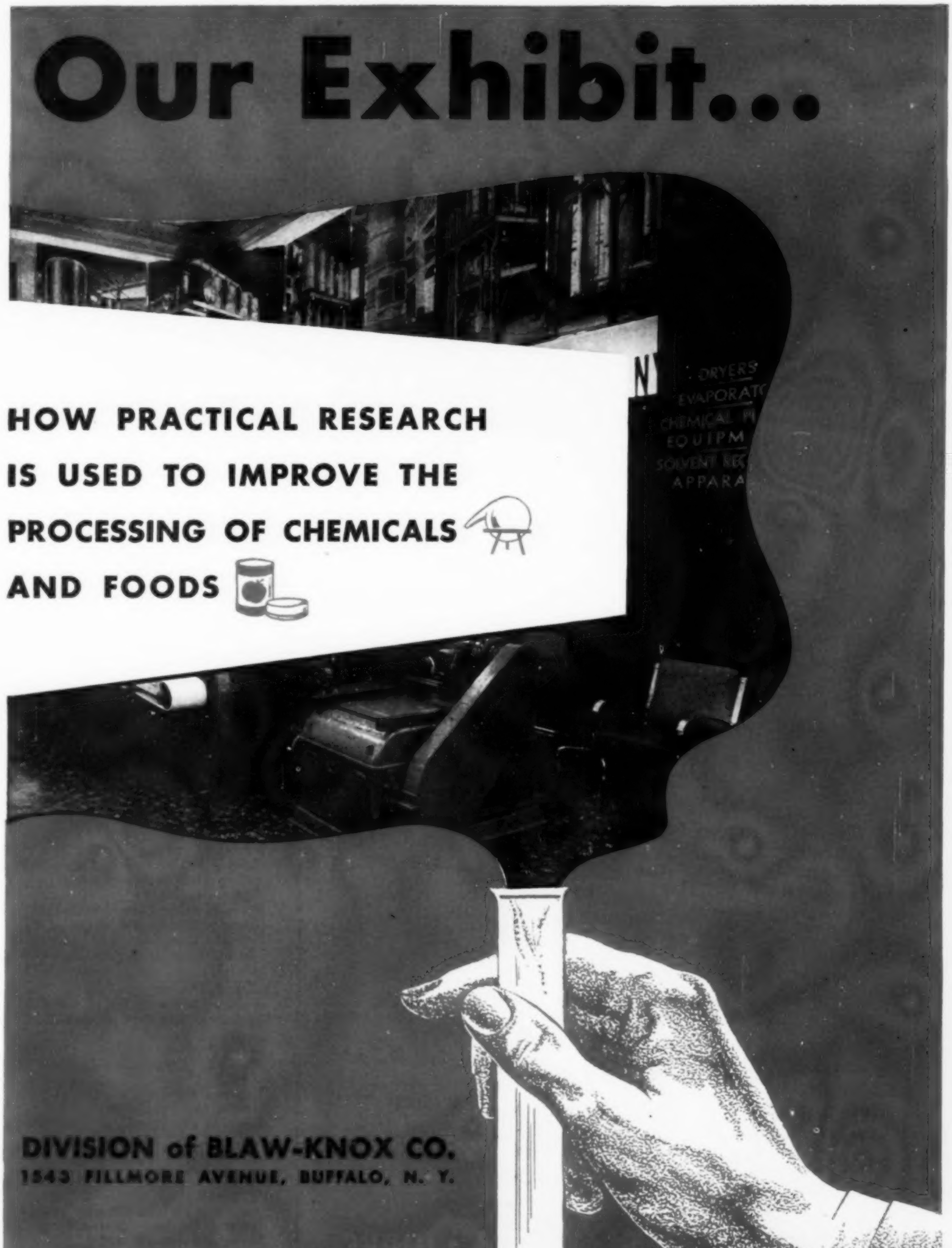
American Instrument Company (334–335)
Coleman Electric Company (339 and A)
Eimer & Amend (57)
Gamma Instrument Company, Inc. (497)
Macbeth Corporation (400)
National Technical Laboratories (300–302)
Photovolt Corporation (285)
Roy Pumps, Milton (433)
Scientific Glass Apparatus Co. (218 to 220)
Standard Scientific Supply Corp. (618)
Taylor & Company, W. A. (337)
Thomas Co, Arthur H. (665–666)
Wallace & Tiernan Products, Inc. (470)
Welch Mfg. Co., W. M. (405)
Will Corp. (621)

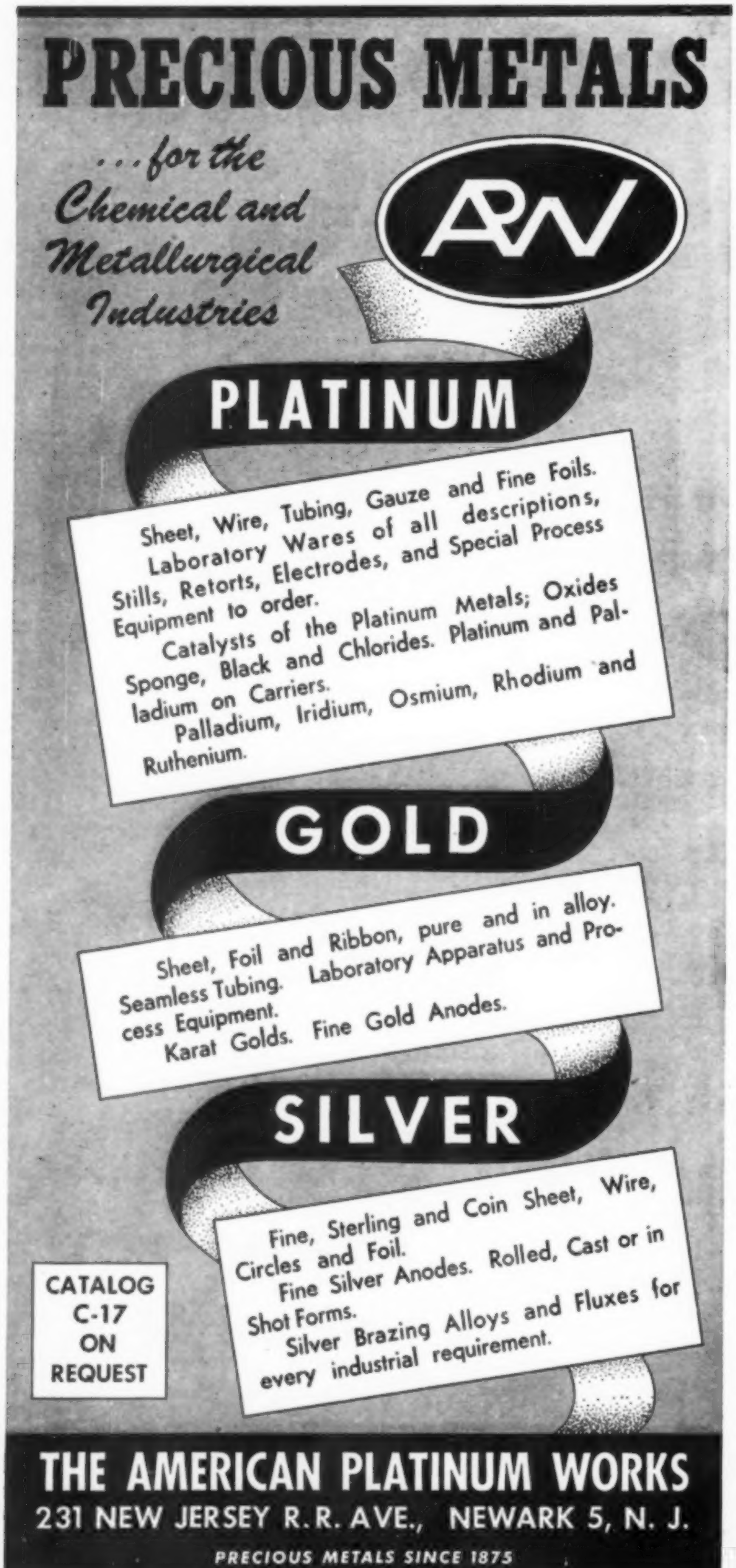
PHARMACEUTICAL MACHINERY

Alsop Engineering Co. (321–322)
Bowen Engineering Inc. (461B)
Eppenbach, Inc. (318)
Ertel Engineering Corp. (508–509)
Fitzpatrick Co. Inc., W. J. (401–402)
Glascote Products, Inc. (655–656)
Hercules Filter Corp. (443–445)
Kiefer Machine Co., Karl (24)
Proctor & Schwartz Inc. (15)
% Proportioneers, Inc. % (477–479)
Pulverizing Machinery Co. (246–247)
Read Machinery Co. (308–309)
Republic Filters, Inc. (556–557)
Selas Corp. of America (533–534)
Stokes Machine Co., F. J. (80)

(*Continued on page* 364)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.


Our Exhibit...
HOW PRACTICAL RESEARCH IS USED TO IMPROVE THE PROCESSING OF CHEMICALS AND FOODS
DIVISION of BLAW-KNOX CO.
1543 FILLMORE AVENUE, BUFFALO, N. Y.



EXHIBITORS
Classified by Products
CONTINUED

PIGMENTS
Aluminum Company of America (70-71)
Dicalite Co. (86)
Reichold Chemicals, Inc. (303-304)

PIPE AND FITTINGS
Allegheny Ludlum Steel Corp. (296-298)
Aluminum Company of America (70-71)
American Hard Rubber Co. (269-270)
American Smelting and Refining Co. (23)
Amersil Co. Inc. (454)
Barco Mfg. Co. (515)
Blickman, Inc., S. (474-475)
Carpenter Steel Co. (539)
Cooper Alloy Foundry Co. (565-566)
Corning Glass Works (332-333—346-347)
Crane Co. (312-313)
Duriron Co. Inc. (19-20)
General Alloys Co. (299)
General Ceramics and Steatite Corp. (2)
Glascote Products, Inc. (655-656)
Grinnell Co. Inc. (290-291)
Haveg Corp. (51)
Haynes Stellite Co. (92)
Illinois Electric Porcelain Co. (672-673)
International Nickel Co. Inc. (9)
Knight, Maurice A. (53)
Laboratory Furniture Co. Inc. (221-222)
Lapp Insulator Co. Inc. (418-419)
Luzerne Rubber Co. (528-529)
National Carbon Co. Inc. (30-31)
National Lead Co. (292-293)
Pfaudler Co. (72-73)
Republic Steel Corp. (434-436)
Tri-Clover Machine Co. (567-568)
United States Steel Corp. (76-77)

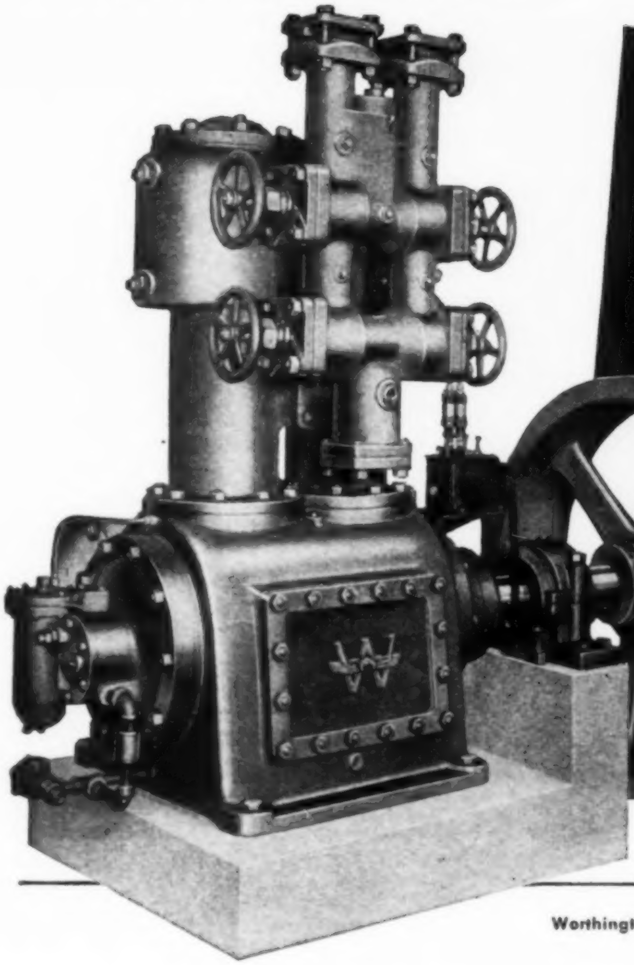
PLASTICS
American Hard Rubber Co. (269-270)
American Resinous Chemicals Corp. (35-36)
Dow Chemical Co. (227-230)
General American Transportation Corp. (326-331)
Haveg Corp. (51)
Hercules Filter Corp. (443-445)
Hercules Powder Co. (W pt 7)
Reichold Chemicals Inc. (303-304)
United States Stoneware Co. (89-90)

PLASTICIZERS
Amecco Chemicals Inc. (648-649)
American Resinous Chemicals Corp. (35-36)
Glyco Products Co. Inc. (223-224)
Hardesty Chemical Co. Inc. (648-649)
Hercules Powder Co. (W pt 7)
Neville Co. (547-548)
Reichold Chemicals Inc. (303-304)

PLATINUM—WIRE, SHEET, FOIL, CRUCIBLES, LABORATORY WARE
American Platinum Works (456)
Baker & Co. Inc. (451-452)
Eimer and Amend (57)
Fisher Scientific Co. (57)
Will Corp. (621)

(Continued on page 366)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.



THE "HEART" OF THE REFRIGERATION SYSTEM

Should have an unfailing "heart" of its own

Worthington Type VSA Refrigeration Compressor, two-cylinder, single-acting, enclosed

The critical component of a refrigeration system is the compressor, and the critical component of a compressor is the valve.

A light strip of flexible steel is responsible in large part for the successful operation of Worthington equipment in food refrigeration. Worthington's famous Feather* Valve — simplest, lightest, quietest, most reliable valve ever developed for compressor work — consists of thin metal strips seating tightly against ground-face slotted seats.

Their easy flexing allows them to lift against the curved guard to permit free passage of refrigerant vapor through the openings in the seat. They close with gradually increasing contact instead of destructive impact. Result: quiet operation, minimum wear, lowest power consumption.

Similar design features make other Worthington equipment the most efficient you can obtain. Since Worthington makes so many of the "vitals" of a refrigeration system, it is possible to install a completely integrated unit consisting almost entirely of components manufactured to industrial standards.

CALL IN YOUR WORTHINGTON DISTRIBUTOR

Whenever you have a problem in industrial refrigeration, your nearby Worthington Air Conditioning and Refrigeration Distributor is a ready source of facts that prove *there's more worth in Worthington*. And for further facts about the Worthington Compressor shown, write for Bulletin C-1100-B18A. *Worthington Pump and Machinery Corporation, Harrison, N. J.*

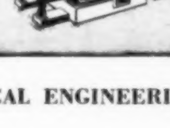
*Reg. U. S. Pat. Off.

WORTHINGTON

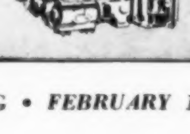
A5-19

FIVE MORE REASONS WHY WORTHINGTON LEADS IN INDUSTRIAL REFRIGERATION

Horizontal compressors for all types of refrigerants



Angle gas engine compressors



Centrifugal compressors

Absorption refrigerating machines

Freon compressors

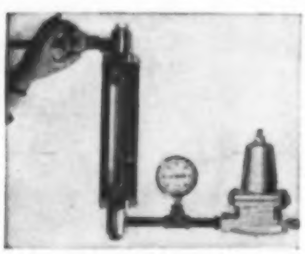
BOOTH 82

Use ANSUL SO_2 and Avoid...

TYPICAL ANALYSIS COMPARISON

Chemical	Ansul Liquid Sulfur Dioxide	Burner Gas	
		Poor Operation	Very Efficient Operation
SO_2	99.9+%	4.90%	19.08%
SO_3	0.00	1.95	0.10
H_2O	less than 0.01	1.47	0.40
S (Sublimed)	0.00	0.49	0.10
N_2	less than 0.10 (L.P.)	76.50	78.32
O_2		13.72	1.00
A		.97	1.00
Ash	0.00	Trace	Trace

An Easy-to-Install Ansul SO_2 System Gives You These Four Important Advantages



HIGHER PURITY—Elimination of impurities inherent in burner gas (Ansul Liquid SO_2 is 99.9+% [by weight] PURE).

GREATER ECONOMY—Small investment in equipment, materially reduced operating and maintenance costs, and freeing of valuable floor space.

FINGER-TIP CONTROL—Easy, positive, finger-tip control providing extreme accuracy for reaction or adjustment of pH.

GREATER SOLUBILITY—Solubility in water is 4 to 5 times greater than SO_2 from burner gas.

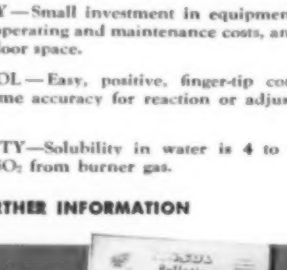
WRITE THE ANSUL TECHNICAL STAFF FOR FURTHER INFORMATION

Liquid Sulfur Dioxide by ANSUL

PHYSICAL PROPERTIES

Chemical formula..............................SO_2
Molecular weight..............................64.06
Color (gas and liquid)..................Colorless
Odor....................Characteristic, pungent
Melting point.............−103.9° F. (−75.5° C.)
Boiling point.................14.0° F. (−10.0° C.)
Density of liquid at 80° F....(85.03 lbs. per cu. ft.)
Specific gravity at 80° F...........................1.363
Density of gas at 0° C. and 760 mm...................2.9267 grams per liter (0.1827 lb. per cu. ft.)
Critical temperature........314.82° F. (157.12° C.)
Critical pressure........1141.5 lbs. per sq. in. abs.
Solubility........................Soluble in water
Purity........................99.9+% (by wt.) SO_2 (H_2O less than 0.01%)

*REG. U. S. PAT. OFF.



Send for Bulletin 020.1, "A Comparison of Ansul SO_2 and Sulfur Burner Gas," and also for your copy of "Liquid Sulfur Dioxide"—a treatise on the properties, characteristics, and industrial uses of Liquid Sulfur Dioxide—written by the Ansul Technical Staff.

WRITE: Dept. D

ANSUL CHEMICAL COMPANY, MARINETTE, WIS.
Eastern Office: 60 E. 42nd St., New York City

EXHIBITORS
Classified by Products
CONTINUED

PRESSES—HYDRAULIC
American Instrument Company (334-335)
Carver, Fred S. (231)
Eimer & Amend (57)
Fisher Scientific Co. (57)
Hydraulic Press Mfg. Company (602)
Stokes Machine Co., F. J. (80)
Will Corp. (621)

PRESSURE RELIEF AND RUPTURE RELIEF DEVICES
Black, Sivalls & Bryson, Inc. (496)
Crane Co. (312-313)
Lapp Insulator Co. Inc. (418-419)
Luzerne Rubber Co. (528-529)
National Lead Co. (292-293)

PROPORTIONING EQUIPMENT
% Proportioneers, Inc. % (477-479)

PUBLISHERS
Chemical Industries (28)
Chemical & Metallurgical Engineering (42)
Edwards Brothers, Incorporated (2N)
Journal of Industrial & Engineering Chemistry (26-27)
Journal of Chemical Education (570)
McGraw-Hill Publishing Co. (42)
Putman Publishing Company (506)
Reinhold Publishing Corporation (26-27)
VanNostrand Co. Inc., D. (85)

PULVERIZERS
Eimer & Amend (57)
Fisher Scientific Co. (57)
Hardinge Company, Inc. (60)
Jay Bee Sales Company (209)
Jeffrey Manufacturing Co. (44A-45)
Pulverizing Machinery Co. (246-247)
Raymond Pulverizer Div.
Combustion Engineering Co. (67)
Sprout, Waldron & Co. (550 to 553)
Thomas Co., Arthur H. (665-666)
Will Corp. (621)
Williams Patent Crusher & Pulverizer Co. (310-311)

PUMPS
Alsop Engineering Co. (321-322)
American Hard Rubber Co. (269-270)
Ace Glass Incorporated (338)
American Instrument Company (334-335)
Dorr Company (64)
Duriron Company, Inc. (19-20)
Continental Equipment Co. (670)
Eastern Engineering Company (344-345)
Eclipse Fuel Engineering Co. (500)
Eco Engineering Company (615)
Ertel Engineering Corporation (508-509)
Fuller Company (263-264)
General Ceramics & Steatite Corp. (2)
Hardinge Company, Inc. (60)
Hasco Valve & Machine Co. (641)
Haveg Corp. (51)
Hills-McCanna Co. (260-261)
Industrial Products Company (611)
Janney Cylinder Company (286)
Kinney Mfg. Co. (468-469)
LaBour Company, Inc. (32)
Lapp Insulator Co. Inc. (418-419)
Luzerne Rubber Co. (528-529)

(*Continued on page 368*)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

FLEXIBLE—TOUGH—CORROSION-RESISTANT

THOSE METALLIC PARTS are coated in the flat. Then they're pressed into cup form; a cup three times deeper than its greatest diameter. The VINYLITE resin flexible coating doesn't crack, wrinkle, or separate from the steel at any point. And along with this adaptability for extreme forming goes the fact that properly formulated VINYLITE resin coatings are tasteless, odorless, non-toxic, and remarkably resistant to moisture, alkalies, and acids ... today's outstanding answer for linings for tanks, vats, food and beverage containers, and a whole vast range of closures.

But that's only the start! Air-dried or low-baked, VINYLITE resin coatings are unsurpassed for a great variety of special coating jobs on every kind of metal. Their amazing resistance to most chemical conditions establishes new concepts of toughness and durability in maintenance coatings—for industrial equipment and plants alike. Certain formulations are widely used for the protection of concrete. Structural board makers employ their sleek, impervious finishes for cement-asbestos tile.

Specify coatings based on VINYLITE resins for the last word in flexibility, adhesion, and corrosion resistance. For coatings manufacturers and interested users, detailed information about the properties and uses of these surface coatings—and suggested formulas—are available upon request. Simply write Department 46-A.

BAKELITE CORPORATION
Unit of
Union Carbide and Carbon Corporation
UCC
30 EAST 42ND ST., NEW YORK 17, N. Y.

Vinylite Plastics
TRADE-MARK

EXHIBITORS
Classified by Products
CONTINUED

Marco Company, Inc. (646–647)
McIntyre Co. (467)
National Carbon Co. Inc. (30–31)
National Lead Co. (292–293)
New Jersey Machine Corp. (485–486)
Oliver United Filters, Inc. (66)
% Proportioneers, Inc. % (477 to 479)
Roy Pumps, Milton (433)
Schutte & Koerting Company (319–320)
Shriver & Company, Inc., T. (12)
Stokes Machine Co., F. J. (80)
Tri-Clover Machine Co. (567–568)
U. S. Stoneware Co. (89–90)
Wallace & Tiernan Products, Inc. (470)
Waukesha Foundry Co. (524 to 527)
Welch Mfg. Co., W. M. (405)
Will Corp. (621)
Worthington Pump & Machinery Corp. (267–268)

PYROMETERS
Eimer & Amend (57)
Engelhard, Inc., Charles (455)
Illinois Testing Laboratories, Inc. (38)
Will Corp. 621)

QUARTZ
Amersil Company, Inc. (454)
Hanovia Chemical & Mfg. Company (457–458)

RAW MATERIAL
Bareco Oil Company (629–630)
Evans Chemetics, Inc. (461)
Glyco Products Co. Inc. (223–224)
Hercules Powder Co. (W pt 7)

RAYON EQUIPMENT
Aluminum Company of America (70–71)
American Hard Rubber Co. (269–270)
American Smelting & Refining Co. (23)
Baker & Co. Inc. (451–452)
Baker Perkins, Inc. (62–63)
Fischer & Porter Co. (212–214)
Hercules Filter Corporation (443–445)
Luzerne Rubber Co. (528–529)
National Lead Co. (292–293)
Proctor & Schwartz, Inc. (15)
Read Machinery Co. Inc. (308–309)
Sperry & Co., D. R. (540–542)
Swenson Evaporator Company
Div. Whiting Corp. (43)

RECORDING INSTRUMENTS
Davis Emergency Equipment Co. Inc. (679)
Engelhard, Inc., Charles (454)
Fischer & Porter Company (212-214)
Mine Safety Appliances Company (210A–210B–210C)
Omega Machine Co. (479)
Uehling Instrument Co. (202)
Will Corp. (621)

REFRACTORIES
Carborundum Company (91)
Eimer & Amend (57)
Fisher Scientific Co. (57)
Johns-Manville (93–94)
Munn & Steele, Inc. (569)

(*Continued on page* 372)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

Two Valves in One: Simply reverse the position of the body sections and the new "United" Type "R" Valve is changed from a "Y" pattern to an Angle pattern.

Removable Seat and Plug-Disc in Any Alloy: Not only the plug disc but the seat itself is removable for easy, economical maintenance. Or seat and plug of any desired alloy can be installed.

NATIONAL LEAD'S VERSATILE UNITED TYPE "R" VALVE SLICES INVENTORY AND MAINTENANCE COST

This ingenious new "many purpose" valve offers a combination of advantages unobtainable with valves where body and seat are cast as an integral unit.

For one thing, it can be installed either as a "Y" or Angle pattern, simply by reversing the position of the body section, as shown in the illustration at the right. This enables you to reduce your supply stock by standardizing on one valve with two uses.

Again, since the seat is removable, as well as the plug disc, both can be replaced easily at nominal cost, thereby effecting worthwhile economies in maintenance.

Moreover, seat and plug disc can be fabricated in any alloy you specify... "custom-made" to withstand abrasive or other particularly hard-to-handle fluids. For more normal applications the valve can be furnished three standard ways: 1. With lead plug disc and stem integral; 2. With removable lead plug disc; 3. With removable rubber plug disc.

It is fabricated not only in hard lead but also in lead lined 125 lb. cast iron and 150 lb. cast steel types.

Further information regarding the "United" Type "R" Split-Body Flanged Valves will be furnished gladly upon request.

• • •

Remember, National Lead also manufactures acid valves of many other types, both lead lined and hard lead, in all required sizes and styles... gate, angle, check, diaphragm and free-flow "Y" types... as well as special valves designed to specification.

• • •

No matter what your needs—from lead pipe... to lead lined, covered or lead bonded equipment... to complete acid recovery plants... National Lead is ready to supply you.

Consult our Technical Staff and benefit by years of experience with thousands of lead installations in every field handling corrosive solutions and gases.

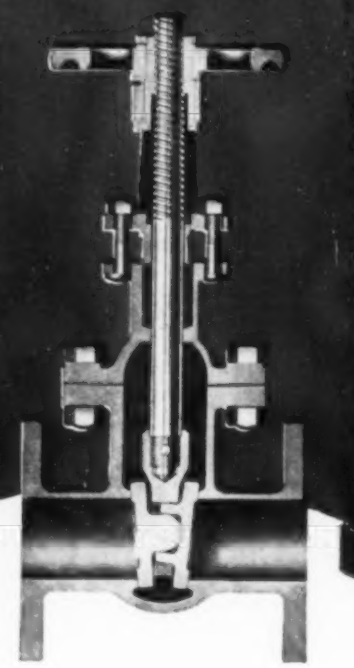
IF ACID HANDLING IS YOUR PROBLEM...

Go "National" for Lead

NATIONAL LEAD COMPANY
111 Broadway, New York 6, N. Y.
Offices and Plants in Principal Cities and Canada

Specify "LUSTRACAST" Electrolytic finish. It not only brightens valve appearance, it insures increased corrosion resistance and adds longer life.

COOPER "CERTIFIED" STAINLESS STEEL VALVES



You specify—We certify

Guessing is no longer a factor in determining whether or not the composition of your Stainless Steel valves meets exact specifications — not since we introduced "Certified" Stainless Steel valves.

Now you can be sure you will get exactly what you need. Because, in production, Cooper *registers* the analysis of each heat and stamps each casting with its heat number. Every Cooper unit, therefore, is positively identified. Duplication of analysis in re-orders is simple. And the chance of a mix-up in storage is greatly lessened.

The Cooper valve certification method applies to all parts which come in contact with the fluid being handled. As a Cooper customer you get your certificate on request with each unit specified.

This method of certifying valves is made possible by Cooper's complete foundry service. The metallurgical, engineering and manufacturing processes, including casting, heat-treating, machining and testing are all here. And everything is under one roof for finger-tip control of each production phase of your valve.

The standard types of Cooper "Certified" Stainless Steel valves now available include: Globe, Gate, Y, Check, Needle, Quick-opening. A complete line of stainless steel pipe fittings are also available.

Cooper's up-to-the-minute facilities for casting intricate stainless steel, monel, and nickel parts are unique. If you use such parts our engineers and metallurgists can offer valuable help. For complete data on "Certified" Stainless Steel valves produced in a money-saving manner, drop us a line — today.

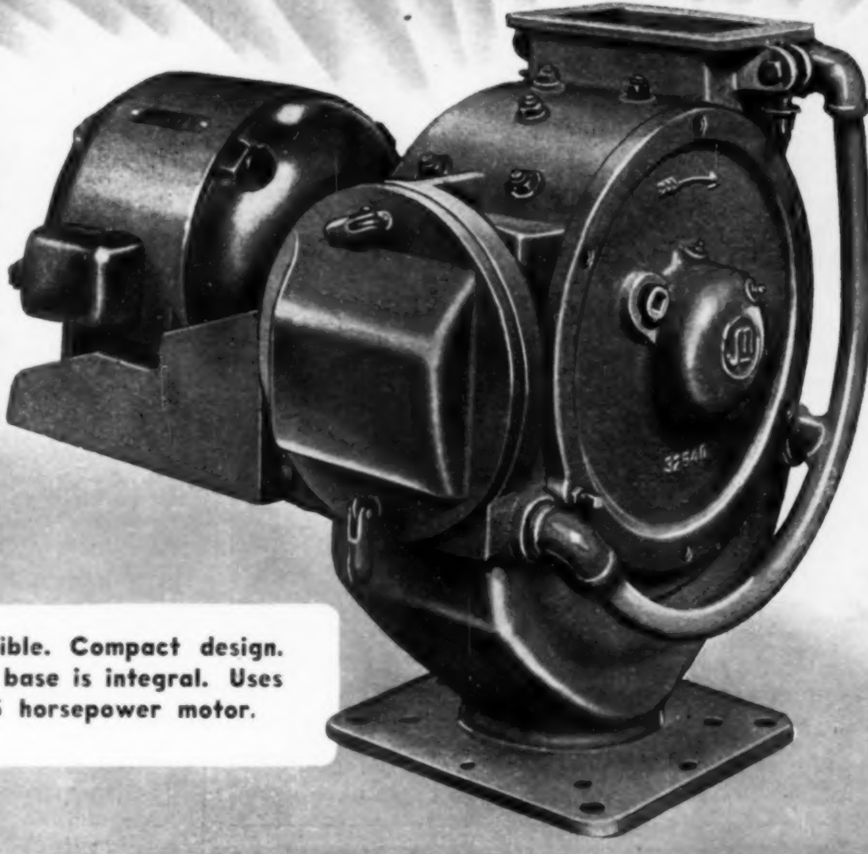
THE ONLY ALLOY FOUNDRY WITH ALL THESE FACILITIES

- Laboratory control over raw materials and finished products.
- Dual foundry . . . both hand and machine molding.
- Electric arc and high-frequency-induction melting furnaces.
- Centrifugally-cast castings.
- Heat treating of castings up to six feet.
- X-ray and Gamma-ray inspection.
- Zyglo detection of surface imperfections.
- Precision Castings.
- Machine shop . . . specially equipped for finishing stainless steel.
- Improved cleaning . . . including Lustracast electrolytic finishing which leaves all surfaces bright.
- Castings furnished rough, polished or fully machined . . . one ounce to two tons.
- Development of special alloys to meet unusual requirements.
- Technical consulting service.

THE COOPER ALLOY FOUNDRY CO.
170 Bloy Street
Hillside, New Jersey

CA-102

THE *Cooper* ALLOY FOUNDRY CO.
STAINLESS • MONEL • NICKEL
THE LARGEST EXCLUSIVE STAINLESS STEEL FOUNDRY IN THE COUNTRY



Accessible. Compact design. Motor base is integral. Uses 3 or 5 horsepower motor.

(Patent Pending)

A NEW MACHINE FOR EITHER WET or DRY GRINDING

Jeffrey has been serving industry for 54 years with Sizing, Crushing, Pulverizing and Shredding equipment.

See this machine at the Show. Booth 45.

THE JEFFREY

MANUFACTURING COMPANY

909-99 North Fourth St., Columbus 16, Ohio

ESTABLISHED 1877

Baltimore 1 · Buffalo 2 · Cleveland 13 · Harlan · Milwaukee 11 · Pittsburgh 22
Birmingham 3 · Chicago 1 · Denver 2 · Houston 5 · New York 7 · St. Louis 3 · Salt Lake City 1
Boston 16 · Cincinnati 2 · Detroit 13 · Huntington 19 · Philadelphia 3 · Scranton 9

EXHIBITORS
Classified by Products
CONTINUED

National Carbon Co. Inc. (30–31)
Norton Co. (415–417)
Titanium Alloy Manufacturing Co. (207–208)
U. S. Stoneware Co. (89–90)

REFRIGERATING EQUIPMENT

Luzerene Rubber Co. (528–529)
Pressed Steel Tank Co. (280 to 282)
Tenney Engineering, Inc. (678)

REGULATORS

Pressure and Temperature
American Instrument Company (334–335)
Crane Co. (312–313)
Eclipse Fuel Engineering Co. (500)
Eimer & Amend (57)
Fisher Scientific Co. (57)
Hoke Incorporated (217)
Matheson Company, Inc. (305)
Sarco Company, Inc. (11)
Superior Electric Co. (522–523)
Tenney Engineering, Inc. (678)
Will Corp. (621)

RESPIRATORS

Davis Emergency Equipment Co. Inc. (679)
Martindale Electric Co. (440)
Mine Safety Appliances Company (210A–210B–210C)
Pangborn Corporation (75)
Will Corp. (621)
Willson Products, Inc. (431–432)

RESINS AND OILS

American Resinous Chemicals Corp. (35–36)
Glyco Products Co. Inc. (223–224)
Hercules Powder Co. (W pt 7)
Neville Company (547–548)
Phillips Petroleum Company (633–634)
Reichhold Chemicals, Inc. (303–304)
U. S. Stoneware Co. (89–90)

ROTOMETERS

Ace Glass, Inc. (338)
Fischer & Porter Company (212 to 214)
Schutte & Koerting Company (319–320)
Selas Corporation of America (533–534)

RUBBER PRODUCTS AND EQUIPMENT

Amecco Chemicals, Inc. (648–649)
American Hard Rubber Co. (269–270)
American Instrument Company (334–335)
American Resinous Chemicals Corp. (35–36)
Bramley Machinery Corporation (520–521)
Eimer & Amend (57)
Fisher Scientific Co. (57)
Garlock Packing Co. (323–324)
Hardesty Chemical Co. Inc. (648–649)
Heil Engineering Co. (575)
Hercules Powder Co. (W pt 7)
Hills-McCanna Company (260–261)
Luzerne Rubber Co. (528–529)
U. S. Stoneware Co. (89–90)
Will Corp. (621)

(*Continued on page 375*)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

EXHIBITORS
Classified by Products
CONTINUED

RUST PROOFING
American Resinous Chemicals Corp. (35–36)
Bareco Oil Company (629–630)
Lukens Steel Company & Subs. (558 to 563)

SAFETY EQUIPMENT
Black, Sivalls & Bryson, Inc. (496)
Cayne, Albert H. (638–640)
Davis Emergency Equipment Co. Inc. (679)
Eriez Manufacturing Co. (632)
Industrial Products Company (611)
Martindale Electric Co. (440)
Mine Safety Appliances Company 210A–210B–210C)
Pioneer Rubber Company (429)
Willson Products, Inc. (431–432)

SALT
Dow Chemical Company (227–230)
Titanium Alloy Manufacturing Company (207–208)

SCALES
Eimer & Amend (57)
Exact Weight Scale Company (476)
Fisher Scientific Co. (57)
% Proportioneers, Inc. % (477 to 479)
Scientific Glass Apparatus Co. (218 to 220)
Toledo Scale Company (443)
Welch Mfg. Co., W. M. (405)
Will Corp. (621)

SCREENS—INCLINED, VIBRATING, GYRATORY
Gump Company, B. F. (205–206)
Productive Equipment Corp. (549)
Read Machinery Co. Inc. (308–309)
Richmond Mfg. Co. (441)
Sprout, Waldron & Co. (550 to 553)
Syntron Company (265–266)
Tyler Co., W. S. (88)
Williams Patent Crusher & Pulverizer Co. (310–311)

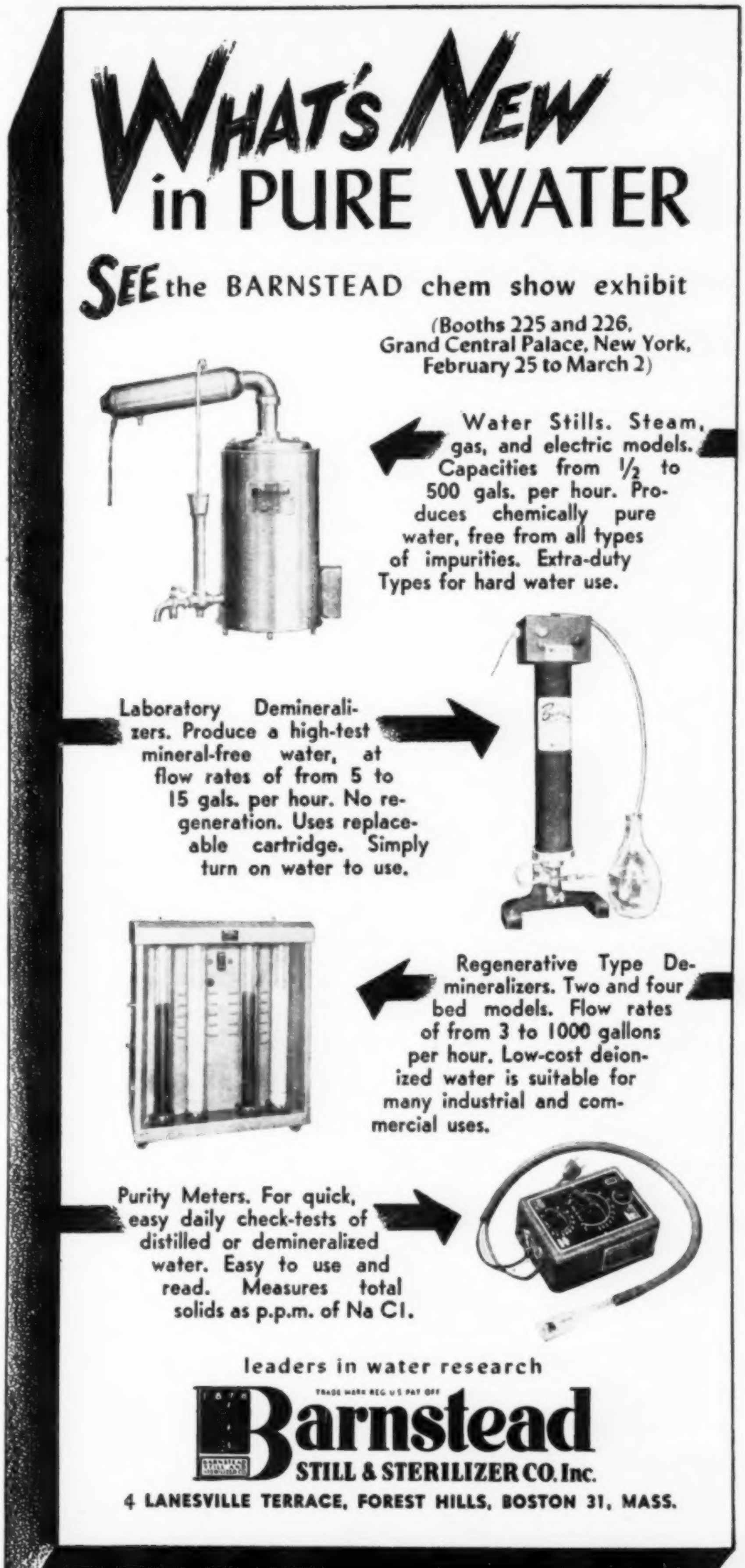
SCREENS—OTHER
Bartlett & Snow Co., C. O. (487–488)
Bramley Machinery Corporation 520–521)
Dorr Company (64)
Newark Wire Cloth Company (83–84)
Tyler Co., W. S. (88)

SEALING MACHINES
PerfeKtum Products Co. (215–216)
Pneumatic Scale Corp. Ltd. (22)
Triangle Package Machinery Co. (564)

SEPARATORS
American Hard Rubber Co. (269–270)
Baker Perkins, Inc. (62–63)
Bird Machine Co. (535–536, 543–544)
Centrifuge Mechanical Equipment, Inc. (671)
Eriez Manufacturing Co. (632)
Federal Classifier Systems, Inc. (404)
Fletcher Works, Inc. (25)
Frantz Co. Inc., S. G. (501)
Hardinge Company, Inc. (60)
Raymond Pulverizer Div., Combustion Engineering Co. (67)
Ritter Products Co. (33)

(*Continued on page* 376)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.



EXHIBITORS
Classified by Products
CONTINUED

Selas Corporation of America (533-534)
Sharples Corporation (58-59)
Sprout, Waldron & Co. (550-553)
Tolhurst Centrifugals Div., American Machine & Metals, Inc. (68-69)
Williams Patent Crusher & Pulverizer Co. (310-311)

SHEET METAL WORK
Blickman, Inc., S. (474-475)
Cayne, Albert H. (638-640)
Falstrom Company (510-511)
Koven & Bro., Inc., L. O. (248-249)
Sprout, Waldron & Co. (550-553)

SIEVES—LABORATORY
American Instrument Company (334-335)
Eimer & Amend (57)
Newark Wire Cloth Company (83-84)
Richmond Mfg. Co. (441)
Scientific Glass Apparatus Co. (218-220)
Thomas Co., Arthur H. (665-666)
Welch Mfg. Co., W. M. (405)
Will Corp. (621)

SIFTERS
American Instrument Company (334-335)
Great Western Manufacturing Co. (209A-210)
Gump Company, B. F. (205-206)
Newark Wire Cloth Company (83-84)
Productive Equipment Corp. (549)
Read Machinery Co. Inc. (308-309)
Richmond Mfg. Co. (441)
Sprout, Waldron & Co. (550-553)
Tyler Co., W. S. (88)

SILICA
Amersil Company, Inc. (454)
Hanovia Chemical & Mfg. Company (457-458)

SINKS—LABORATORY, ACID PROOF
Alberene Stone Corp. of Virginia (79)
American Hard Rubber Co. (269-270)
Eimer & Amend (57)
General Ceramics & Steatite Corp. (2)
Hamilton Manufacturing Co. (244-245)
Kewaunee Mfg. Co. (250-253)
Koven & Bro., Inc., L. O. (248-249)
Laboratory Furniture Co. Inc. (221-222)
Luzerne Rubber Co. (528-529)
Metalab Equipment Corp. (504)
National Lead Co. (292-293)
Peterson & Co. Inc., Leonard (442)
Stanley Company, A. B. (624)
U. S. Stoneware Co. (89-90)

SIZERS
Dorr Company (64)
General American Transportation Corp. (326-331)
Ritter Products, Division of Ritter Co. Inc. (33)

SLEEVES
Janney Cylinder Company (286)
(*Continued on page* 378)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.


FRONTIERS OF HEALTH
Laboratory Research
In the advancement of man's health, there is no "last frontier." New fields are constantly opening up. Old fields keep widening.
Forward strides in group health are marked by better balanced meals, more nourishing foods, improved housing, safer working conditions. More effective drugs and pharmaceuticals used in therapeutics and preventive medicine are likewise bringing about similar improvement in the well-being of individuals.
Common to the many frontiers of health are research activities maintained uninterruptedly and on an extensive scale. An example is the scope of the research carried on by Chas. Pfizer & Co., Inc.
In the company's laboratories, chemists, biochemists, bacteriologists and other highly trained personnel are engaged in the development of chemicals and vitamins for food enrichment and for the production of pharmaceuticals used in combating disease. Pfizer research has been a major factor in the present day mass production of penicillin.
Since its founding in 1849, Chas. Pfizer & Co., Inc., has followed a policy of progress through research. Chas. Pfizer & Co., Inc., 81 Maiden Lane, New York 7, N. Y.; 444 West Grand Ave., Chicago 10, Ill.
PFIZER QUALITY
PFIZER
Manufacturing Chemists Since 1849

EXHIBITORS
Classified by Products
CONTINUED

SOLVENT RECOVERY EQUIPMENT
Ansul Chemical Co. (82)
Artisen Metal Products Inc. (540–542)
Blaw-Knox Division of Blaw-Knox Co. (13–14)
Davis Emergency Equipment Co. Inc. (679)
Ertel Engineering Corporation (508–509)
Fansteel Metallurgical Corp. (314–317)
Fischer & Porter Co. (212–214)
Hercules Filter Corporation (443 to 445)
Hercules Powder Co. (W pt 7)
Koven & Bro., Inc., L. O. (248–249)
Niagara Blower Company (493 to 495)
Patterson-Kelley Co. Inc. (295)
Porter Company, Inc., H. K. (256–257)
Read Machinery Co. Inc. (308–309)
Selas Corporation of America (533–534)
Stokes Machine Co., F. J. (80)

SOLVENTS
Amecco Chemicals, Inc. (648–649)
American Resinous Chemicals Corp. (35–36)
Atlas Powder Co. (46–47)
Commercial Solvents Corp. (55)
Dow Chemical Co. (227–230)
Eimer & Amend (57)
Fisher Scientific Co. (57)
Hardesty Chemical Co. Inc. (648–649)
Neville Company (547–548)
Phillips Petroleum Co. (633–634)

SPRAY DRYING SYSTEMS
Bowen Engineering Inc. (461B)
Swenson Evaporator Company
Div. of Whiting Corp. (43)

SPEED REDUCERS
Cleveland Worm & Gear Co. (502–503)
Farval Corporation (502–503)
Mixing Equipment Co. Inc. (273–274)
Patron Transmission Co. (617 & 643)
Philadelphia Gear Works, Inc. (78)
Reeves Pulley Co. of N. Y., Inc. (34)

STAIR STEPS—SAFETY
Blaw-Knox Division of Blaw-Knox Co. (13–14)
Lukens Steel Company and Subs. (558–563)
Norton Co. (415–417)

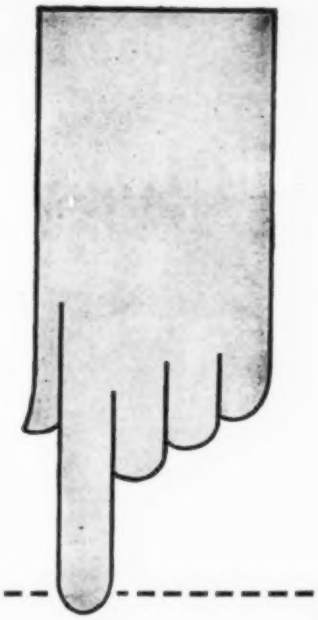
STEEL GRATING AND FLOORING
Blaw-Knox Division of Blaw-Knox Co. (13–14)

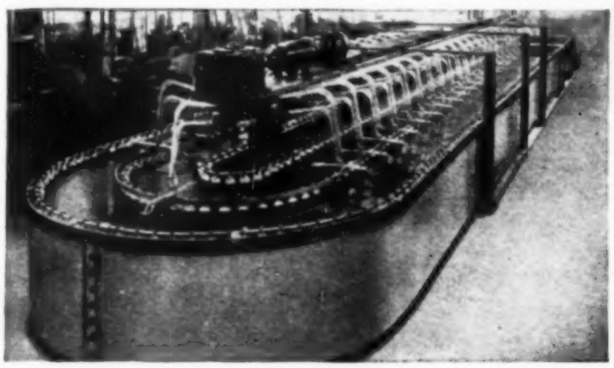
STERILIZERS
Aetna Scientific Co. (262)
Eimer & Amend (57)
Electric Hotpack Company, Inc. (642)
Koven & Bro., Inc., L. O. (248–249)
Standard Scientific Supply Corp. (618)
Thomas Co., Arthur H. (665–666)
Will Corp. (621)

(*Continued on page 380*)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

Eliminate Corrosion ON 3 FRONTS





Ace rubber lined sectional tank for paper processing

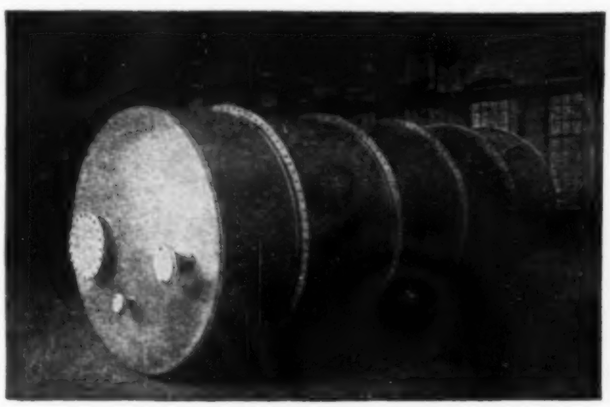
1. Prevent damage to finished product.

2. End contamination of valuable chemical solutions.

3. Avoid deterioration of equipment.

Draft Ace Hard Rubber in your war on corrosion affecting circulating, storage and processing operations. Ace Hard Rubber has been employed in leading industrial plants for corrosion-resistant services for nearly 75 years ... with significant and substantial economies. Put Ace Hard Rubber to work in your plant—write for "ACE RUBBER PROTECTION", 64 page catalog containing important information for plant executives.

American Hard Rubber Company
11 Mercer Street, New York 13, N. Y.



Ace rubber lined return-type plating tank

Ace Hard Rubber

Hard and Soft Rubber Lined Tanks, Pipe and Fittings
All-Hard Rubber Pipe, Fittings and Utensils
Hard Rubber Pumps in a Wide Range of Sizes and Capacities
Made-to-Specification Equipment—Hard Rubber and Hard Rubber Lined

EXHIBITORS
Classified by Products
CONTINUED

STILLS
Aetna Scientific Co. (262)
Artisan Metal Products Inc. (540–542)
Barnstead Still & Sterilizer Co. Inc. (225–226)
Blickman, Inc., S. (474–475)
Fansteel Metallurgical Corp. (314 to 317)
General Ceramics & Steatite Corp. (2)
Glascote Products, Inc. (655–656)
Koven & Bro., Inc., L. O. (248–249)
National Lead Co. (292–293)
Pfaudler Co. (72–73)
Porter Company, Inc., H. K. (256–257)
Scientific Glass Apparatus Co. (218 to 220)
Stokes Machine Co., F. J. (80)
Thomas Co., Arthur H. (665–666)
Welch Mfg. Co., W. M. (405)
Will Corp. (621)

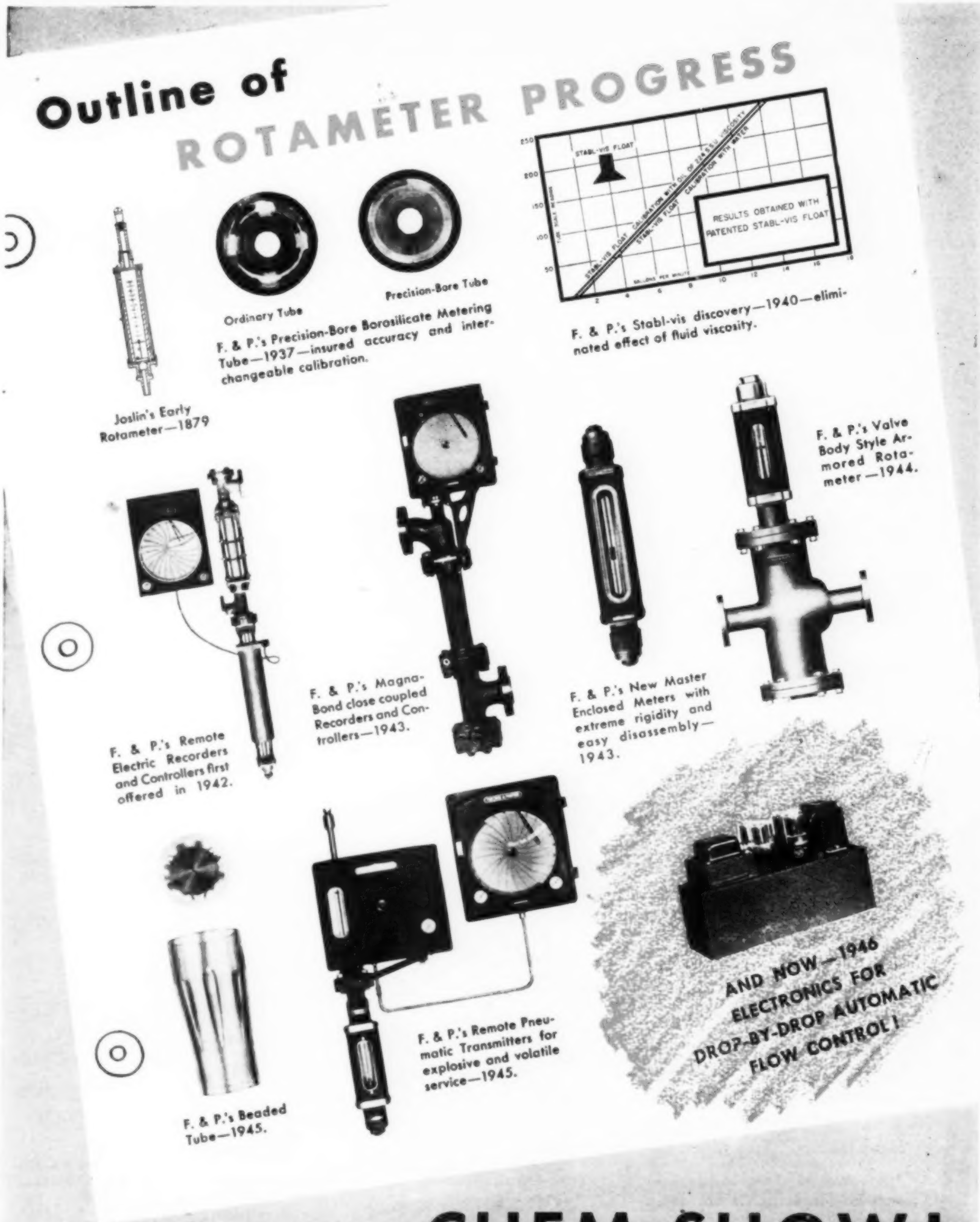
STRAINERS
Blackburn-Smith Mfg. Co. Inc. (461A)
Bramley Machinery Corporation (520–521)
Corning Glass Works (332–333–346–347)
Duriron Company, Inc. (19–20)
Eriez Manufacturing Co. (632)
Monarch Manufacturing Works, Inc. (201)
Newark Wire Cloth Company (83–84)
Sarco Company, Inc. (11)

STRAPPING—STEEL
Acme Steel Company (427–428)

TACHOMETERS
Reeves Pulley Co. of N. Y. Inc. (34)
Will Corp. (621)

TANKS
Aetna Scientific Co. (262)
Alsop Engineering Co. (321–322)
Aluminum Company of America (70–71)
American Hard Rubber Co. (269–270)
American Smelting & Refining Co. (23)
Artisan Metal Products Inc. (540–542)
Blickman, Inc., S. (474–475)
Black, Sivalls & Bryson, Inc. (496)
Duriron Company, Inc. (19–20)
Ertel Engineering Corporation (508–509)
Fansteel Metallurgical Corp. (314 to 317)
General American Transportation Corp. (326–331)
Glascote Products, Inc. (655–656)
Haveg Corp. (51)
Heil Engineering Company (575)
Koven & Bro., Inc., L. O. (248–249)
Knight, Maurice A. (53)
Luzerne Rubber Company (528–529)
Metal-Glass Products Co. (425–426)
National Carbon Co. Inc. (30–31)
National Lead Co. (292–293)
Patterson-Kelley Co. Inc. (295)
Pfaudler Co. (72–73)
Porter Company, Inc., H. K. (256–257)
Pressed Steel Tank Co. (280 to 282)
Trent Company, Harold E. (573)
U.S. Stoneware Co. (89–90)
(*Continued on page* 380)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.



SEE IT AT THE 1946 CHEM SHOW!

Grand Central Palace — N. Y. C. — 25 February to 2 March (Booths 212-213-214)

FISCHER & PORTER COMPANY • HATBORO, PA.

NEW YORK · CHICAGO · DETROIT · BUFFALO · PHILADELPHIA · SAN FRANCISCO · HOUSTON · PITTSBURGH · TULSA · COLUMBUS

EXHIBITORS
Classified by Products
CONTINUED

(*Continued on page* 388)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

EXHIBITOR-ADVERTISER SECTION

EXHIBITORS
Classified by Products
CONTINUED

Sprout, Waldron & Co. (550 to 553)
Waterbury Tool Division of Vickers Incorporated (616)
Worthington Pump & Machinery Corp. (267-268)

TUBES

Aluminum Company of America (70-71)
American Hard Rubber Co. (269-270)
American Smelting & Refining Co. (23)
Amersil Company, Inc. (454)
Baker & Co. Inc. (451-452)
Carpenter Steel Company (539)
Fischer & Porter Company (212 to 214)
Globe Steel Tubes Co. (537-538)
Hanovia Chemical & Mfg. Company (457-458)
National Carbon Co. Inc. (30-31)
National Lead Co. (292-293)
North American Philips Co. Inc. (574)
Norton Co. (415-417)
Republic Steel Corporation (434 to 436)
Schutte & Koerting Company (319-320)
Tri-Clover Machine Co. (567-568)
United States Steel Corp. (76-77)
U. S. Stoneware Co. (89-90)

TRAPS

Eriez Manufacturing Co. (632)
Sarco Company, Inc. (11)

ULTRA VIOLET LAMPS

Ace Glass, Inc. (338)
Eimer & Amend (57)
Hanovia Chemical & Mfg. Company (457-458)
Photovolt Corporation (285)
Will Corp. (621)

UNLOADERS

Fletcher Works, Inc. (25)

VALVES AND FITTINGS

Alloy Steel Products Company (651-652)
American Hard Rubber Co. (269-270)
American Instrument Company (335)
American Smelting & Refining Co. (23)
Black, Sivalls & Bryson, Inc. (496)
Cooper Alloy Foundry Co. (565-566)
Corning Glass Works (332-333—346-347)
Crane Co. (312-313)
Continental Equipment Company (670)
Duriron Company, Inc. (19-20)
Eimer & Amend (57)
General Alloys Co. (299)
General Ceramics & Steatite Corp. (2)
Hasco Valve and Machine Co. (641)
Haveg Corp. (51)
Hills-McCanna Company (260-261)
Hoke Incorporated (217)
Illinois Electric Porcelain Company (672-673)
Janney Cylinder Company (286)
Kinney Manufacturing Co. (468-469)
Knight, Maurice A. (53)
Lapp Insulator Co. Inc. (418-419)
Leslie Company (676)

(Continued on page 392)

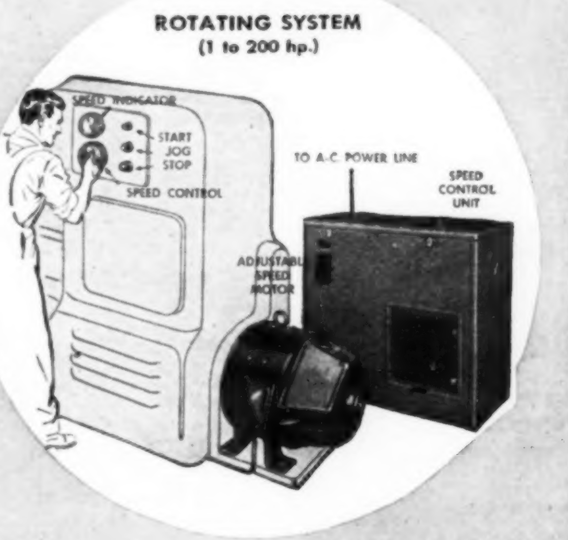
Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

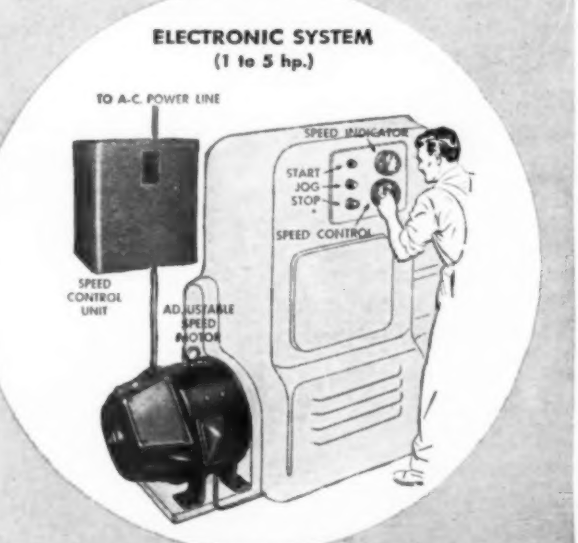
Why pay more than you need

to get D-c. Power where you want it?

RELIANCE V★S DRIVE

SAVE $25 to $60 per Kilowatt of installed D-c. capacity with RELIANCE V★S DRIVE





If in your plant—as in so many others—there is a need for supplying D-c. power for adjustable-speed operations, you are likely to find that *spot conversion of A-c. power* with the Reliance V★S Drive is the perfect answer. This is true for two reasons.

FIRST—V★S DRIVE saves you from $25 to $60 per kilowatt as compared to the cost of bringing in and applying D-c. power from some central source. These figures are based on a wide variety of applications.

SECOND—V★S DRIVE gives you unlimited flexibility of machine operation and application. This includes both automatic and manual control with smooth starting, stopping and reversing. Also, an infinite range of stepless speed changes, automatically maintained tension and many other specialized advantages.

Before installing D-c. power lines, learn what you can save with Reliance V★S Drive, which operates from your regular A-c. circuits. And see what V★S, with all-electric control, can do in improving quality and quantity of output, while reducing installation, operating and maintenance costs. Write today for the up-to-date story on spot conversion of A-c to D-c power.

We'll be looking for you at Booths 674 and 675
(4th floor)
20TH EXPOSITION OF CHEMICAL INDUSTRIES
Grand Central Palace • New York • Week of February 25th

RELIANCE ELECTRIC & ENGINEERING CO.
1063 Ivanhoe Road • Cleveland 10, Ohio

Birmingham • Boston • Buffalo • Chicago • Cincinnati • Denver • Detroit • Gary Greenville • Houston • Kalamazoo • Kansas City • Knoxville • Los Angeles Milwaukee • Minneapolis • New Orleans • New York • Philadelphia • Pittsburgh Portland, Ore. • Rockford, Ill. • St. Louis • San Francisco • Seattle • Syracuse Tampa • Tulsa • Washington, D. C.

RELIANCE A-C D-C MOTORS

"Motor-Drive is More Than Power"

EXHIBITORS
Classified by Products
CONTINUED

Luzerne Rubber Co. (528–529)
Matheson Company, Inc. (305)
Monarch Manufacturing Works, Inc. (201)
National Carbon Co. Inc. (30–31)
National Lead Co. (292–293)
Pfaudler Co. (72–73)
Philadelphia Gear Works, Inc. (78)
Powell Company, Wm. (54)
Tri-Clover Machine Co. 567–568)
U. S. Stoneware Co. (89–90)
Walworth Company (254–255)
Worthington Pump & Machinery Corp. (267–268)

VENTILATING APPARATUS
American Air Filter Co. Inc. (489–491)
American Foundry Equipment Co. (481 to 484)
De Bothezat Fans Div.
American Machine and Metals, Inc. (68–69)
Falstron Co. (510–511)
Kewaunee Mfg. Co. (250 to 253)
Koven & Bro., Inc., L. O. (489 to 491)

VIBRATORS
Gump Co., B. F. (205–206)
Syntron Company (265–266)
Tyler Co., W. S. (88)

VITAMINS
Pfizer & Co. Inc., Chas. (5)

WASHING MACHINES
PerfeKtum Products Co. (215–216)

WATER CONDITIONING EQUIPMENT
% Proportioneers, Inc. % (477 to 479)

WATER ION EXCHANGERS & EQUIPMENT
Barnstead Still and Sterilizer Co. (225–226)
Permutit Company (663)

WATERPROOFING COMPONDS
American Resinous Chemicals Corp. (35–36)
Barecco Oil Company (629–630)
Glyco Products Co. Inc. (223–224)
Johns-Manville (93–94)
Titanium Alloy Manufacturing Co. (207–208)
U. S. Stoneware Co. (89–90)

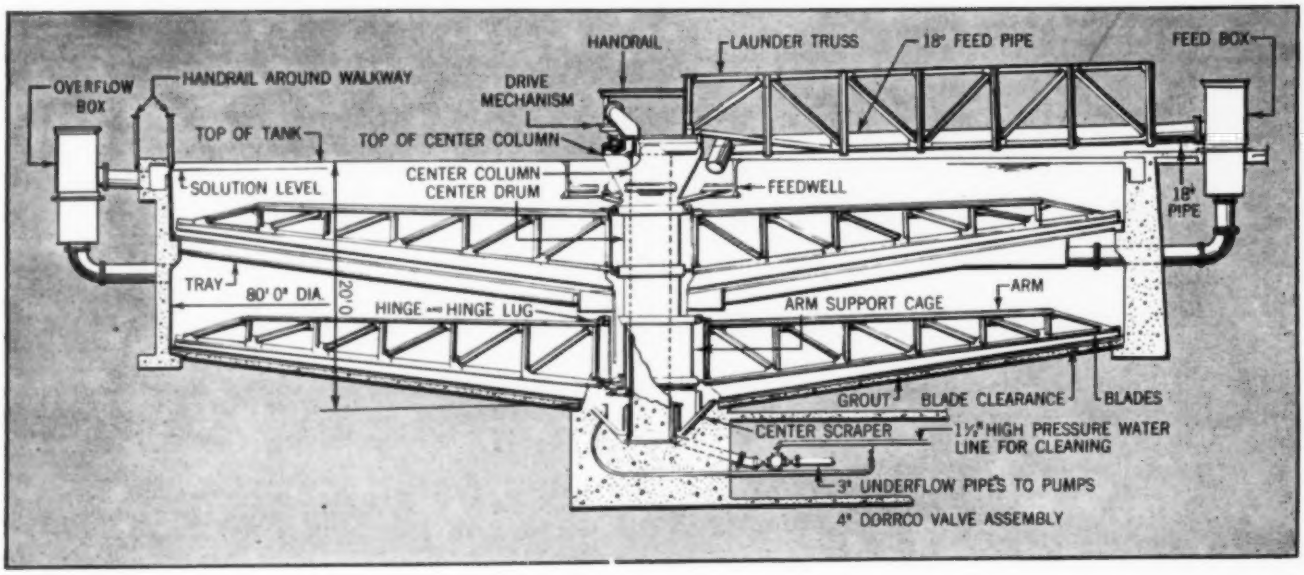
WATER SOFTENING EQUIPMENT
Ace Glass, Inc. (338)
Dorr Company (64)
Eimer & Amend (57)
Lapp Insulator Co. Inc. (418–419)
Luzerne Rubber Co. (528–529)
Omega Machine Co. (479)
Permutit Company (663)
% Proportioneers, Inc. % (477 to 479)
Worthington Pump & Machinery Corp. (267–268)

WAXES
Barecco Oil Company 629–630)

(*Continued on page* 394)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.

This Torq Balanced Tray Thickener has rakes that STEP OVER TROUBLE



HERE'S an end to stalls and breakage from thickener overloads! The Dorr Torq Balanced Tray Thickener with its unique features takes tray obstructions in its stride.

When loads mount up beyond the limit of safety, knee-action of the rakes takes them up and over the obstruction without straining, twisting or stalling that would cause damage or require manual lifting of the rakes in less flexible types of thickeners. While going over, the rakes continue to dig in at full capacity, removing a part of the obstruction with each successive revolution, without effort or attention on the operator's part.

Only the Dorr Torq Balanced Tray Thickener offers processors the advantages of this automatic overload relief along with Exclusive Balanced Tray construction and positive sludge seal. Each compartment of the Dorr Torq Balanced Tray Thickener functions as an individual thickener. Compartments are arranged in parallel, each with separate feed and overflow but having a single sludge discharge in common. Continuous thickening with maximum density of underflow is thus effected in less space than in batch thickening, or in types of tray thickeners not designed for 100% utilization of the area of each tray.

Dorr engineers are at your call to discuss the application of Dorr Torq Balanced Tray Thickeners to your requirements. Consult our nearest office.

Blueprint Now!
FOR TOMORROW'S NEEDS

DORRCO

THE DORR COMPANY, ENGINEERS

NEW YORK 22, N. Y. . . 570 LEXINGTON AVE.
ATLANTA 3, GA. . . WILLIAM-OLIVER BLDG.
TORONTO 1, ONT. . . . 80 RICHMOND ST. W.
CHICAGO 1, ILL. . . . . 221 NO. LA SALLE ST.
DENVER 2, COLO. . . . . COOPER BUILDING
LOS ANGELES 14, CAL. . . . 811 WEST 7TH ST.

RESEARCH AND TESTING LABORATORIES
WESTPORT, CONN.

SUGAR PROCESSING
PETREE & DORR DIVISION
570 LEXINGTON AVE., NEW YORK 22, N. Y.

DORR

RESEARCH ■ ENGINEERING ■ EQUIPMENT

ADDRESS ALL INQUIRIES TO OUR NEAREST OFFICE

EXHIBITORS
Classified by Products
CONTINUED

WELDING EQUIPMENT
Davis Emergency Equipment Co. Inc. (679)
Eutectic Welding Alloys Co. (462 to 464)
Willson Products, Inc. (431)

WIRE CLOTH
Aluminum Company of America (70-71)
American Platinum Works (456)
Baker & Co. Inc. (451-452)
Eimer & Amend (57)
Newark Wire Cloth Company (83-84)
Richmond Mfg. Co. (441)
Roebling's Sons Company, John A. (203-204)
Tyler Co., W. S. (88)

WIRE ROPE
Roebling's Sons Co., John A. (203-204)

X-RAY EQUIPMENT
North American Philips Co. Inc. (574)
Picker X-Ray Corporation (492)

Compiled from information supplied to National Chemical Exposition. No responsibility assumed for errors or omissions.